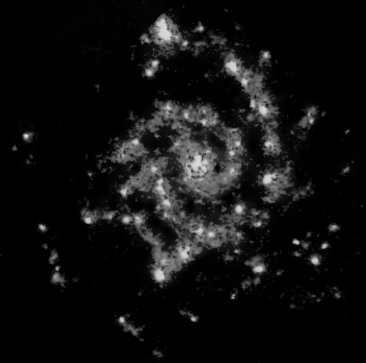
Scientific and Technical Aerospace Reports



An Abstract Journal

Volume 31, Number 7
July 1993
N93-19959 to N93-22008

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Citations and abstracts of reports and publications that provide comprehensive coverage of worldwide aerospace-related topics including aeronautics and space science technology. *STAR* lists published and publicly available reports entered into the NASA STI Database during the four weeks preceding publication of this issue. These citations and abstracts are listed by subject categories.

An Index Section
- Subject
- Personal author
- Corporate source
- Contract number
- Report number.

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N.A.—no abstracts were assigned to this category for this issue.

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28 PROPELLANTS AND FUELS **1863**
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Includes product sampling procedures and techniques; and quality control.

39 STRUCTURAL MECHANICS **1920**
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GEOSCIENCES For related information see also *Space Sciences.*

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Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography. For instrumentation see *35 Instrumentation and Photography.*

44 ENERGY PRODUCTION AND CONVERSION **1982**
Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower. For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

45 ENVIRONMENT POLLUTION **1989**
Includes atmospheric, noise, thermal, and water pollution.

46 GEOPHYSICS **1995**
Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For space radiation see *93 Space Radiation.*

47 METEOROLOGY AND CLIMATOLOGY **2001**
Includes weather forecasting and modification.

48 OCEANOGRAPHY **2017**
Includes biological, dynamic, and physical oceanography; and marine resources. For related information see also *43 Earth Resources and Remote Sensing.*

LIFE SCIENCES

51 LIFE SCIENCES (GENERAL) **2021**

52 AEROSPACE MEDICINE **2022**
Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

53 BEHAVIORAL SCIENCES **2025**
Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT **2025**
Includes human engineering; biotechnology; and space suits and protective clothing. For related information see also *16 Space Transportation.*

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Includes exobiology; planetary biology; and extraterrestrial life.

MATHEMATICAL AND COMPUTER SCIENCES

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Includes feedback and control theory, artificial intelligence, robotics and expert systems. For related information see also *54 Man/System Technology and Life Support.*

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Includes iteration, difference equations, and numerical approximation.

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Includes mathematical modeling; network analysis; and operations research.

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Includes topology and number theory.

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For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

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Includes sound generation, transmission, and attenuation. For noise pollution see *45 Environment Pollution.*

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Includes elementary and nuclear particles; and reactor theory. For space radiation see *93 Space Radiation.*

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Includes light phenomena and optical devices. For lasers see *36 Lasers and Masers.*

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Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see *46 Geophysics.* For space plasmas see *90 Astrophysics.*

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Includes superconductivity. For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

77 THERMODYNAMICS AND STATISTICAL PHYSICS **2084**
Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics. For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

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Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT **2085**
Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE **2087**
Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography. For computer documentation see *61 Computer Programming and Software.*

83 ECONOMICS AND COST ANALYSIS **2093**
Includes cost effectiveness studies.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY **2093**
Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION ..... **N.A.**
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation. For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

SPACE SCIENCES For related information see also *Geosciences.*

88 SPACE SCIENCES (GENERAL) ..... **N.A.**

89 ASTRONOMY **2094**
Includes radio, gamma-ray, and infrared astronomy; and astrometry.

90 ASTROPHYSICS **2096**
Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust. For related information see also *75 Plasma Physics.*

91 LUNAR AND PLANETARY EXPLORATION **2098**
Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

92 SOLAR PHYSICS **2100**
Includes solar activity, solar flares, solar radiation and sunspots. For related information see *93 Space Radiation.*

93 SPACE RADIATION **2102**
Includes cosmic radiation; and inner and outer earth's radiation belts. For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

GENERAL

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

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TYPICAL CITATION AND ABSTRACT

NASA SPONSORED
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ACCESSION NUMBER
N93-10068*# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
CORPORATE SOURCE
TITLE
AIR-SEA INTERACTION AND REMOTE SENSING Status Report, 1 Dec. 1991 - 30 Nov. 1992
AUTHORS
Kristina B. Katsaros and Serhad S. Ataktuerk 1992 12 p Original contains color illustrations
PUBLICATION DATE
CONTRACT OR GRANT
(Grant NAGw-1322)
REPORT NUMBERS
(NASA-CR-190913; NAS 1.26:190913) Avail: CASI HC
AVAILABILITY SOURCE
PRICE CODE
A03/MF A01; 2 functional color pages
The first part of the proposed research was a joint effort between our group and the Applied Physics Laboratory (APL), University of Washington. Our own research goal is to investigate the relation between the air-sea exchange processes and the sea state over the open ocean and to compare these findings with our previous results obtained over a small body of water namely, Lake Washington. The goals of the APL researchers are to study (1) the infrared sea surface temperature (SST) signature of breaking waves and surface slicks, and (2) microwave and acoustic scattering from water surface. The task of our group in this joint effort is to conduct measurements of surface fluxes (of momentum, sensible heat, and water vapor) and atmospheric radiation (longwave and shortwave) to achieve our research goal as well as to provide crucial complementary data for the APL studies. The progress of the project is summarized. Author

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Scientific and Technical Aerospace Reports

A Monthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N93-19976*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

RAREFIED-FLOW SHUTTLE AERODYNAMICS MODEL

Robert C. Blanchard, Kevin T. Larman (Lockheed Engineering and Sciences Co., Hampton, VA.), and Christina D. Moats (Lockheed Engineering and Sciences Co., Hampton, VA.) Feb. 1993 26 p

(RTOP 506-48-11-04)

(NASA-TM-107698; NAS 1.15:107698) Avail: CASI HC A03/MF A01

A rarefied-flow shuttle aerodynamic model spanning the hypersonic continuum to the free molecule-flow regime was formulated. The model development has evolved from the High Resolution Accelerometer Package (HiRAP) experiment conducted on the Orbiter since 1983. The complete model is described in detail. The model includes normal and axial hypersonic continuum coefficient equations as functions of angle-of-attack, body flap deflection, and elevon deflection. Normal and axial free molecule flow coefficient equations as a function of angle-of-attack are presented, along with flight derived rarefied-flow transition bridging formulae. Comparisons are made with data from the Operational Aerodynamic Design Data Book (OADDB), applicable wind-tunnel data, and recent flight data from STS-35 and STS-40. The flight-derived model aerodynamic force coefficient ratio is in good agreement with the wind-tunnel data and predicts the flight measured force coefficient ratios on STS-35 and STS-40. The model is not, however, in good agreement with the OADDB. But, the current OADDB does not predict the flight data force coefficient ratios of either STS-35 or STS-40 as accurately as the flight-derived model. Also, the OADDB differs with the wind-tunnel force coefficient ratio data. Author (revised)

N93-20323*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

MULTIDISCIPLINARY COMPUTATIONAL AEROSCIENCES

Paul Kutler Jun. 1992 15 p Original contains color illustrations

(RTOP 505-59-53)

(NASA-TM-103946; A-92127; NAS 1.15:103946) Avail: CASI HC A03/MF A01; 3 functional color pages

As the challenges of single disciplinary computational physics are met, such as computational fluid dynamics, computational structural mechanics, computational propulsion, computational aeroacoustics, computational electromagnetics, etc., scientists have begun investigating the combination of these single disciplines into what is being called multidisciplinary computational aerosciences (MCAS). The combination of several disciplines not only offers simulation realism but also formidable computational challenges. The solution of such problems will require computers orders of magnitude larger than those currently available. Such computer power can only be supplied by massively parallel machines because of the current speed-of-light limitation of conventional serial systems. Even with such machines, MCAS problems will require hundreds of hours for their solution. To efficiently utilize such a machine, research is required in three areas that include parallel architectures, systems software, and applications software. The main emphasis of this paper is the applications software element. Examples that demonstrate application software for multidisciplinary problems currently being solved at NASA Ames Research Center are presented. Pacing items for MCAS are discussed such as solution methodology, physical modeling, computer power, and multidisciplinary validation experiments. Author

N93-20902*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

THE 1992 RESEARCH/TECHNOLOGY REPORT

1992 172 p

(NASA-TM-105924; E-7425; NAS 1.15:105924) Avail: CASI HC A08/MF A02

The 1992 Research & Technology report is organized so that a broad cross section of the community can readily use it. A short introductory paragraph begins each article and will prove to be an invaluable reference tool for the layperson. The approximately 200 articles summarize the progress made during the year in various technical areas and portray the technical and administrative support associated with Lewis technology programs. Author (revised)

N93-21026* National Aeronautics and Space Administration, Washington, DC.

AERONAUTICAL ENGINEERING: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 286)

Jan. 1993 234 p

(NASA-SP-7037(286); NAS 1.21:7037(286)) Avail: CASI HC A11

This bibliography lists 845 reports, articles, and other documents introduced into the NASA scientific and technical information system in Dec. 1992. Subject coverage includes: design, construction and testing of aircraft and aircraft engines; aircraft components, equipment, and systems; ground support systems; and theoretical and applied aspects of aerodynamics and general fluid dynamics. Author

N93-21342# Engineering and Economics Research, Inc., Vienna, VA.

POLAND CIVIL AVIATION MASTER PLAN AND INVESTMENT PROGRAM: EXECUTIVE SUMMARY

1 Jan. 1992 61 p Sponsored by Trade and Development Program

(PB92-213685) Avail: CASI HC A04/MF A01

A study of Poland's airport and airspace systems, including reviews of the Governmental organizational structure supporting aviation and the financial components which seek to support operation of the systems, was conducted. The result of the study is the Civil Aviation Master Plan for Poland. The Executive Summary covers the key findings and most significant project recommendations which need to be implemented to modernize Poland's airport and airspace systems including the organizational and financial support components. The Master Plan also contains an Investment Program which recommends how to finance the needed changes and improvements. It begins by summarizing the aviation forecasts and key findings. It then presents an overview of requirements and recommendations, the Capital Investment Plan, and a summary of the training accomplished during the contract and future training needs. GRA

N93-21343# Engineering and Economics Research, Inc., Vienna, VA.

POLAND CIVIL AVIATION MASTER PLAN AND INVESTMENT PROGRAM Final Report

Jan. 1992 199 p Sponsored by Trade and Development Program

(PB92-213693) Avail: CASI HC A09/MF A03

The Government of Poland and the United States Trade and Development Program (TDP) reached an agreement in mid-1990 through which the TDP provided a grant to Poland for developing a Civil Aviation Master Plan and Investment Program for the 1992-2005 timeframe. The general scope of the work included: development of forecasts for growth; a review of selected airports throughout Poland; a review of the existing airspace system, including air traffic control (ATC), airspace structure and management, navigation

systems, communications systems; an institutional and review of the General Inspectorate of Civil Aviation (GILC) and the Polish Airports State Enterprise (PPL); a review of the PPL financial operations and tariff structure and the development of a financial model; and development of a Civil Aviation Master Plan, including an Investment Program. GRA

N93-21713# CORE International, Inc., Washington, DC.
DEFINITIONAL MISSION FOR CIVIL AVIATION MASTER PLAN FOR POLAND
Vinod K. Shrivastava and James R. Banks Jun. 1990 35 p Sponsored by Trade and Development Program
(PB92-213974) Avail: CASI HC A03/MF A01

A definitional mission was conducted to investigate Poland's airport and airspace systems, including reviews of the governmental organizational structure supporting aviation and the financial components which seek to support operation of the systems. An overview of the existing system, an assessment of requirements, and the mission's recommendations are presented. Author (revised)

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N93-19968*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
AN EXPERIMENTAL INVESTIGATION OF S-DUCT FLOW CONTROL USING ARRAYS OF LOW-PROFILE VORTEX GENERATORS
Bruce A. Reichert and Bruce J. Wendt Feb. 1993 14 p Presented at the 31st Aerospace Sciences Meeting and Exhibit, Reno, NV, 11-14 Jan. 1993; sponsored by AIAA
(RTOP 505-62-52)
(NASA-TM-106030; E-7595; NAS 1.15:106030) Copyright Avail: CASI HC A03/MF A01

An experimental investigation was undertaken to measure the effect of various configurations of low-profile vortex generator arrays on the flow in a diffusing S-duct. Three parameters that characterize the vortex generator array were systematically varied to determine their effect: (1) the vortex generator height; (2) the streamwise location of the vortex generator array; and (3) the vortex generator spacing. Detailed measurements of total pressure at the duct exit, surface static pressure, and surface flow visualization were gathered for each vortex generator configuration. These results are reported here along with total pressure recovery and distortion coefficients determined from the experimental data. Each array of vortex generators tested improved total pressure recovery. The configuration employing the largest vortex generators was the most effective in reducing total pressure recovery. No configuration of vortex generators completely eliminated the flow separation that naturally occurs in the S-duct, however the extent of the separated flow region was reduced. Author (revised)

N93-19973*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A GRIDLESS EULER/NAVIER-STOKES SOLUTION ALGORITHM FOR COMPLEX-AIRCRAFT APPLICATIONS
John T. Batina Feb. 1993 13 p Presented at the AIAA 31st Aerospace Sciences Meeting, Reno, NV, 11-14 Jan. 1993 Previously announced in IAA as A93-21107
(RTOP 505-63-50-12)
(NASA-TM-107727; NAS 1.15:107727) Avail: CASI HC A03/MF A01

The development of a gridless computational fluid dynamics (CFD) method for the solution of the two- and three-dimensional Euler and Navier-Stokes equations is described. The method uses only clouds of points and does not require that the points be connected to form a grid as is necessary in conventional CFD algorithms. The gridless CFD approach appears to resolve the inefficiencies encountered with structured or unstructured grid methods, and consequently offers great potential for accurately and efficiently solving viscous flows about complex aircraft configurations. The method is described in detail and calculations are presented for standard Euler and Navier-Stokes cases to assess the accuracy and efficiency of the capability. Author

N93-20017 Department of the Navy, Washington, DC.
AERODYNAMIC SURFACE TIP VORTEX ATTENUATION SYSTEM Patent
Robert M. Taylor, inventor (to Navy) 27 Oct. 1992 12 p Filed 16 Nov. 1990
(AD-D015606; US-Patent-5,158,251; US-Patent-Appl-SN-614411) Avail: US Patent and Trademark Office

Apparatus and method for attenuating fluid foil tip vortices, featuring a 'Coanda tip' and a 'Coanda curtain' are discussed. The fluid foil tip has a Coanda surface and means for discharging compressed fluid adjacent thereto; a resultant fluid barrier is formed generally chordwise and perpendicular to the fluid foil plane and tangential to the fluid foil tip upon Coanda entrainment and deflection of the discharged compressed fluid. The fluid barrier prevents crossflow from the higher pressure fluid region to the lower pressure fluid region, the fluid regions being separated by the fluid foil when moving relatively through a fluid, the fluid barrier thereby stemming tip vortex generation at its source. GRA

N93-20018*# Rice Univ., Houston, TX. Dept. of Mechanical Engineering and Materials Science.
THE SEMI-DISCRETE GALERKIN FINITE ELEMENT MODELLING OF COMPRESSIBLE VISCOUS FLOW PAST AN AIRFOIL Final Technical Report, 1 Jan. - 31 Dec. 1992
Andrew J. Meade, Jr. 31 Dec. 1992 80 p
(Grant NAG1-1196)
(NASA-CR-192161; NAS 1.26:192161) Avail: CASI HC A05/MF A01

A method is developed to solve the two-dimensional, steady, compressible, turbulent boundary-layer equations and is coupled to an existing Euler solver for attached transonic airfoil analysis problems. The boundary-layer formulation utilizes the semi-discrete Galerkin (SDG) method to model the spatial variable normal to the surface with linear finite elements and the time-like variable with finite differences. A Dorodnitsyn transformed system of equations is used to bound the infinite spatial domain thereby permitting the use of a uniform finite element grid which provides high resolution near the wall and automatically follows boundary-layer growth. The second-order accurate Crank-Nicholson scheme is applied along with a linearization method to take advantage of the parabolic nature of the boundary-layer equations and generate a non-iterative marching routine. The SDG code can be applied to any smoothly-connected airfoil shape without modification and can be coupled to any inviscid flow solver. In this analysis, a direct viscous-inviscid interaction is accomplished between the Euler and boundary-layer codes, through the application of a transpiration velocity boundary condition. Results are presented for compressible turbulent flow past NACA 0012 and RAE 2822 airfoils at various freestream Mach numbers, Reynolds numbers, and angles of attack. All results show good agreement with experiment, and the coupled code proved to be a computationally-efficient and accurate airfoil analysis tool. Author (revised)

N93-20169# George Washington Univ., Washington, DC. School of Engineering and Applied Science.
SHOCK-DEPENDENT, OPTIMUM THRUST WINGS IN SUPERSONIC FLOW Ph.D. Thesis
James Lee Pittman 21 Dec. 1992 141 p
Avail: CASI HC A07/MF A02

A new wing concept that reduces the inviscid drag of a wing in supersonic flow is presented. This wing concept utilizes a secondary shock that occurs aft of the maximum thickness location to produce a significant aerodynamic thrust force from the aft portion of the wing, thereby reducing the inviscid drag. The increased aft-wing thrust force is created by contouring each streamwise airfoil aft of the maximum thickness location to obtain a more favorable orientation of the local wing surface. The aerodynamic thrust force has generally been associated with the near leading-edge region of a wing previously. The secondary shock is clearly identified and favorably exploited herein for the first time. Dissert. Abstr.

N93-20235*# MCAT Inst., San Jose, CA.
TURBULENCE MODELING FOR HYPERSONIC FLIGHT Final Report
Jorge E. Bardina Feb. 1993 32 p

(Contract NCC2-585)
(NASA-CR-192288; NAS 1.26:192288; MCAT-93-07) Avail: CASI HC A03/MF A01

The objective of the proposed work is to continue to develop, verify, and incorporate the baseline two-equation turbulence models, which account for the effects of compressibility at high speeds, into a three-dimensional Reynolds averaged Navier-Stokes (RANS) code. Additionally, we plan to provide documented descriptions of the models and their numerical procedures so that they can be implemented into the NASP CFD codes.
Derived from text

N93-20256*# Computational Mechanics Co., Austin, TX.
ADVANCED ADAPTIVE COMPUTATIONAL METHODS FOR NAVIER-STOKES SIMULATIONS IN ROTORCRAFT AERODYNAMICS
S. T. Stowers, J. M. Bass, and J. T. Oden Mar. 1993 37 p
(Contract NAS2-13285)
(NASA-CR-192282; NAS 1.26:192282; TR-93-02) Avail: CASI HC A03/MF A01

A phase 2 research and development effort was conducted in area transonic, compressible, inviscid flows with an ultimate goal of numerically modeling complex flows inherent in advanced helicopter blade designs. The algorithms and methodologies therefore are classified as adaptive methods, which are error estimation techniques for approximating the local numerical error, and automatically refine or unrefine the mesh so as to deliver a given level of accuracy. The result is a scheme which attempts to produce the best possible results with the least number of grid points, degrees of freedom, and operations. These types of schemes automatically locate and resolve shocks, shear layers, and other flow details to an accuracy level specified by the user of the code. The phase 1 work involved a feasibility study of h-adaptive methods for steady viscous flows, with emphasis on accurate simulation of vortex initiation, migration, and interaction. Phase 2 effort focused on extending these algorithms and methodologies to a three-dimensional topology. Author

N93-20288 Oklahoma Univ., Norman.
COMPUTATIONAL ANALYSIS OF HYPERSONIC FLOWS PAST GENERALIZED CONE-DERIVED WAVERIDERS Ph.D. Thesis
Xiaohai He 1992 208 p
Avail: Univ. Microfilms Order No. DA9238469

A comprehensive inviscid and viscous numerical simulation of hypersonic flow past non-conical rounded-nose waveriders is presented. A new set of parameters is introduced into the formulation of waverider configurations that provides a systematic way to generate waverider shapes in terms of various design considerations. The flow field and aerodynamic forces at off-design conditions are solved inviscidly by a space marching CFD code with the initial data plane provided by a time marching Navier-Stokes CFD code. The numerical method uses a flux difference splitting algorithm. A grid system generated by elliptic differential equations is developed, and its distribution near the sharp leading edge of a waverider is properly handled. Off-design conditions include off-design Mach numbers, angles of attack, and rounded leading edges. A wide range of waverider configurations, including waveriders with reflexed trailing edges and relatively thick waveriders with large leading-edge angles, is numerically investigated and compared. On-design viscous flows past a waverider with a sharp leading edge at M infinity = 4 and at different Reynolds numbers and temperature boundary conditions are obtained by a time-marching Navier-Stokes solver on an off-site IBM super computer. These calculations show the effects of viscous interactions which are influential near the leading edges.
Dissert. Abstr.

N93-20405# Naval Surface Weapons Center, Dahlgren, VA.
IMPROVED EMPIRICAL MODEL FOR BASE DRAG PREDICTION ON MISSILE CONFIGURATIONS BASED ON NEW WIND TUNNEL DATA Final Report
Frank G. Moore, Floyd Wilcox, and Tom Hymer Oct. 1992 57 p
(AD-A258753; NSWCDD/TR-92/509) Avail: CASI HC A04/MF A01

New wind tunnel data have been taken, and a new empirical model has been developed for predicting base drag on missile configurations. The new wind tunnel data were taken at NASA/LaRC in the Unitary Plan Wind Tunnel at Mach numbers from 2.0 to 4.5, angles of attack to 16 deg, fin control deflections up to 20 deg, fin thickness-to-chord (t/c) ratio of 0.05 to 0.15, and fin locations flush with the base to two chord lengths upstream of the base. The newly developed empirical model uses these data along with previous wind tunnel data. It estimates base drag as a function of all the above variables along with boattail and power-on or power-off effects. In comparing the new empirical model to that used in the former aeroprediction code, the new model gives improved accuracy over wind tunnel data. The new model also is more robust due to inclusion of additional variables. On the other hand, additional wind tunnel data are needed to validate or modify the current empirical model in areas where data are not available. GRA

N93-20806# Manchester Univ. (England). Aeronautical Engineering Group.
THE AERODYNAMIC PERFORMANCE OF LASER DRILLED SHEETS
D. I. A. Poll, M. Danks, and B. E. Humphreys (Aerospace Systems and Technologies, Stanley, England.) 1992 6 p Sponsored by British Aerospace Regional Aircraft Ltd. and Commission of the European Communities
(Aero-Rept-9204; ETN-93-93004) Avail: CASI HC A02/MF A01

The aerodynamic characteristics of laser drilled titanium sheets were investigated. In the context of laminar flow applications, the most important issues are the pressure drop across the surface for a given mass flow rate per unit area and the nominal hole diameter. In order to investigate these a simple flow model was developed for an ideal hole. This shows that the pressure drop is a quadratic function of the mass flow rate. Data for eight perforated sheets are presented in terms of the parameters contained within the model. Operating ranges for these parameters are identified. A method for the specification of suction surface geometry, which facilitates accurate manufacture and subsequent quality control, is proposed. ESA

N93-20807# Manchester Univ. (England). Aeronautical Engineering Group.
THE EFFECT OF SURFACE SUCTION NEAR THE LEADING EDGE OF A SWEPT-BACK WING
D. I. A. Poll, M. Danks, and A. J. Davies (British Aerospace Regional Aircraft Ltd., Hatfield, England.) 1992 8 p Sponsored by British Aerospace Regional Aircraft Ltd. and Commission of the European Communities
(Aero-Rept-9205; ETN-93-93005) Avail: CASI HC A02/MF A01

The problem of boundary layer transition in the immediate vicinity of a swept leading edge was investigated. The geometry and associated Reynolds numbers were such that the tests were effectively super flight scale. Of specific interest were the issues of attachment line contamination and cross flow instability since these are known to be 'barrier' problems in the design of swept, laminar flow wings. Boundary layer suction was provided by means of laser drilled holes in a titanium surface. Preliminary results indicated that without suction, and with an uncontaminated attachment line flow, transition occurs through cross flow instability. When suction was used, cross flow transition could be effectively delayed by very low through surface velocities. Comparisons between the impervious surface data and the predictions of the linear stability theory + e(sup 9) model for transition were made. The agreement was found to be good for the attachment line flow but poor for cross flow. ESA

N93-20911# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.
WIND-TUNNEL EXPERIMENTS ON WIND EFFECTS AT TUNNEL PORTALS
R. A. Maarsingh and L. Swart (Ministry of Transport and Waterways, Utrecht, Netherlands.) 14 May 1991 22 p Presented at 7th International Symposium on Aerodynamics and Ventilation of Vehicle Tunnels, Brighton, England, 27-29 Nov. 1991
(NLR-TP-91191-U; ETN-93-93321) Avail: CASI HC A03/MF A01

Results of wind tunnel measurements intended to determine both wind induced pressures and recirculation effects at the portals of a vehicle tunnel with longitudinal ventilation are described. As for the wind induced pressures it was established that simulation of the ventilation flow in the model is essential in order to obtain correct results. The recirculation studies, executed by both concentration measurements and flow visualization, revealed several different flow patterns which may induce specific types of recirculation, depending on the main variables involved (wind velocity and direction, and portal geometry). ESA

N93-21054# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Hubschrauber und Flugzeuge.

HEAT LOADS AS KEY PROBLEM OF HYPERSONIC FLIGHT

E. H. Hirschel 1 Jul. 1992 26 p Presented at Hermann-Oberth-Gesellschaft 40th Raumfahrtkongress, Gosen/Berlin, Germany, 6 Jun. 1991 Submitted for publication

(MBB-FE-202-S-PUB-0486; ETN-93-93425) Avail: CASI HC A03/MF A01

Different heat load problems, that occur in the airframe during hypersonic flight, and their solutions are addressed. Surface radiation cooling is the key for external parts to drastically reduce heat loads. However, this makes necessary specific surface properties, especially a high radiation emissivity, small catalytic recombination effects, and depending on the material, an effective oxidation protection. The close coupling of aerothermodynamic and materials properties and the resulting prediction and simulation problems are discussed. Several examples are used for illustration purposes. ESA

N93-21058# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Military Aircraft Div.

CALCULATION OF HYPERSONIC, VISCOUS, NON-EQUILIBRIUM FLOWS AROUND REENTRY BODIES USING A COUPLED BOUNDARY LAYER/EULER METHOD

Christian Mundt Jul. 1992 18 p Presented at 27th AIAA Thermophysics Conference, Nashville, TN, 6-8 Jul. 1992 Previously announced in IAA as A92-47839

(MBB-LME-211-S-PUB-0487; ETN-93-93429) Copyright Avail: CASI HC A03/MF A01

A new and efficient method for the calculation of hypersonic, viscous flows in chemical non-equilibrium is presented. The solution is obtained by using a coupled second order boundary layer/Euler method. This accounts for important hypersonic effects such as entropy layer swallowing. Applications are presented for two dimensional flow fields to validate the method and to analyze various physical and chemical effects. Three dimensional flows past the nose of the Hermes vehicle are calculated. This shows the suitability of the method. ESA

N93-21059# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Military Aircraft Div.

APPLICATION OF THE EULER METHOD EUFLEX TO A FIGHTER-TYPE AIRPLANE CONFIGURATION AT TRANSONIC SPEED

Stefan Heiss, Albrecht Eberle, Luciano Fornasier, and Wolfgang Paul Jun. 1992 23 p Presented at 10th AIAA Applied Aerodynamics Conference, Palo Alto, CA, 22-24 Jun. 1992 Previously announced in IAA as A92-45573 Sponsored by MBB

(MBB-FE-211-S-PUB-0489-A; ETN-93-93430) Copyright Avail: CASI HC A03/MF A01

The application of the finite volume Euler method, EUFLEX, to an advanced fighter airplane configuration using an H type and monoblock grid topology is reported. Comparisons of the numerical results with wind tunnel data, both in terms of global aerodynamic coefficients and of swing surface pressures, are used to assess the capabilities of the present approach in the analysis of complex flow phenomena experienced by the aircraft throughout its flight envelope. Investigated phenomena include the following: flow nolinearities induced by the highly swept delta wing at moderate to high angles of attack and by recompression shocks at transonic and supersonic speeds; and interference flows due to wing canard coupling, underwing pylon missile installation close to wing tip pod, and propulsion effects. Trailing edge flap deflection is simulated using a novel local grid topology. A description of the Euler solver is provided, and the interactive technique used to generate the numerical grid directly from the computer aided design model of the configuration is presented. Selected results for Mach numbers 0.60, 0.90, 1.20, and 1.30 are discussed. ESA

N93-21556*# Complere, Inc., Palo Alto, CA.

AN ASSESSMENT OF LASER VELOCIMETRY IN HYPERSONIC FLOW Final Report

Sep. 1992 227 p

(Contract NAS2-12853)

(NASA-CR-190895; NAS 1.26:190895) Avail: CASI HC A11/MF A03

Although extensive progress has been made in computational fluid mechanics, reliable flight vehicle designs and modifications still cannot be made without recourse to extensive wind tunnel testing. Future progress in the computation of hypersonic flow fields is restricted by the need for a reliable mean flow and turbulence modeling data base which could be used to aid in the development of improved empirical models for use in numerical codes. Currently, there are few compressible flow measurements which could be used for this purpose. In this report, the results of experiments designed to assess the potential for laser velocimeter measurements of mean flow and turbulent fluctuations in hypersonic flow fields are presented. Details of a new laser velocimeter system which was designed and built for this test program are described. Author

N93-21562*# George Washington Univ., Washington, DC. School of Engineering and Applied Science.

PROGRAM OF RESEARCH IN FLIGHT DYNAMICS IN THE JIAFS AT NASA-LANGLEY RESEARCH CENTER Annual Status Report, 1 Dec. 1991 - 30 Nov. 1992

30 Nov. 1992 6 p

(Contract NCC1-29)

(NASA-CR-191885; NAS 1.26:191885) Avail: CASI HC A02/MF A01

The program objectives are fully defined in the original proposal entitled 'Program of Research in Flight Dynamics in the Joint Institute for the Advancement of Flight Sciences (JIAFS) at NASA-Langley Research Center,' which was originated March 20, 1975 and in the renewal of the research program dated December 1, 1991. The program includes four major topics: (1) the improvement of existing methods and development of new methods for flight test data analysis; (2) the application of these methods to real flight test data obtained from advanced airplanes; (3) the correlation of flight results with wind tunnel measurements; and (4) the modeling, and control of aircraft, space structures, and spacecraft. Derived from text

N93-21659# European Space Agency, Paris (France).

ANALYTIC FORMULATION OF UNSTEADY PROFILE AERODYNAMICS AND ITS APPLICATION TO SIMULATION OF ROTORS [ANALYTISCHE FORMULIERUNG DER INSTATIONAEREN PROFILBEIWERTE UND DEREN ANWENDUNG IN DER ROTORSIMULATION]

Berend vanderWall (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick, Germany.) Aug. 1992 172 p Transl. into ENGLISH of Analytische Formulierung der Instationaeren Profilbeiwerte und Deren Anwendung in der Rotorsimulation (Brunswick, Germany, DLR), Mar. 1990 117 p Original language document was announced as N91-13415

(ESA-TT-1244; DLR-FB-90-28; ETN-93-93080) Avail: CASI HC A08/MF A02; original German version available from DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

A new approach to the modeling of rotor aerodynamics is addressed. The steady state aerodynamic coefficients for an aerofoil section are described in terms of a set of analytical equations. The periodically varying velocities over the aerofoil section can then be converted into similarly periodic displacements of angle of attack and stall angle of attack. These can then be fed directly into the simulation. It is very important to have models of the blade dynamics and induced velocities of sufficient accuracy. For this reason a modal method is used to describe the blade dynamics and the induced velocities are modeled in terms of a rigid, distorted spiral geometry, developed from measurements. Results show that a good compromise was achieved between the requirements for short computation times and accuracy. This is of particular interest with respect to the calculation and design of higher harmonic control systems. ESA

N93-21747# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

LA RECHERCHE AEROSPATIALE BIMONTHLY BULLETIN, NO. 249, MARCH - APRIL

Oct. 1989 81 p

(ONERA-1989-2; ESA-TT-1189) Avail: CASI HC A05/MF A01

Topics covered include: (1) new approach to small transonic perturbations - finite elements numerical solving method. Part 1: Numerical developments; (2) new approach to small transonic perturbations - finite elements numerical solving method. Part 2: Numerical applications; (3) vortex interactions on fixed and oscillating delta wings (water tunnel visualizations); and (4) analysis of the degradation gases of energetic binders in the condensed phase. CASI

N93-21760# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Abt. Aerodynamik der Turbomaschine.
ISOPARAMETRIC FINITE ELEMENT APPROACH TO PARTICLE TRAJECTORY: APPLIED AS AN ANALYSIS TOOL TO CRISP AERODYNAMICS [ISOPARAMETRISCHER FE-ANSATZ ZUR VERFOLGUNG DER PARTIKELBAHNEN UND DESSEN ANWENDUNG ZUR ANALYSE DER STROEMUNG IM CRISP]
Amanuel Melake Nov. 1991 104 p
(DLR-FB-91-40; ETN-93-91929) Avail: CASI HC A06/MF A02; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

A program to resolve the computer flow phenomena of the Counter Rotating Integrated Shrouded Propfan (CRISP) is considered. A particle tracing method was developed based on an isoparametric finite element transformation and interpolation for both the geometry and the velocity components. Four step Runge-Kutta was utilized for the numerical integration. Validity and practical applicability of the method were demonstrated for two and three dimensional flow fields. The particle tracing and the limiting streamlines were used to analyze the three dimensional boundary layer separation and vortices that may occur on shrouded propfans. The computational data used for the analysis of the shrouded propfan was calculated using a Reynolds averaged Navier-Stokes code. ESA

N93-21761# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany). Abt. fuer Numerische Stroemungsmechanik.
AEROTHERMODYNAMIC PROPERTIES OF HYPERSONIC FLOWS OVER RADIATION-ADIABATIC SURFACES Ph.D. Thesis - Technische Univ. [AEROTHERMODYNAMISCHE EIGENSCHAFTEN VON HYPERSCHALLSTROEMUNGEN UEBER STRAHLUNGSADIABATE OBERFLAECHEN]
Stefan Riedelbauch 18 Nov. 1991 131 p In GERMAN Original contains color illustrations
(DLR-FB-91-42; ETN-93-91931) Avail: CASI HC A07/MF A02; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

The aerothermodynamic properties of hypersonic flows over radiation adiabatic surfaces are investigated by the numerical simulation of the viscous flow field past a delta wing. The compressible Navier-Stokes equations are solved by an implicit nonfactorized finite difference algorithm with upwind discretization and TVD (Total Variation Diminishing) property. Laminar flow is assumed. The validation of the scheme with experimental and other numerical results is sketched. Algebraic methods are used for grid generation. A simple procedure of grid adaptation for the bow shock is described. The inviscid and viscous flow fields are analyzed in detail. Locally increased surface temperatures are caused by the attachment lines on the windward and the leeward side of the wing. The radiation-adiabatic surface temperature is compared with results obtained by approximate methods. The influence of the variation of characteristic flow parameters and length scales on the radiation adiabatic surface temperature is discussed. ESA

N93-21763# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany). Inst. fuer Experimentelle Stroemungsmechanik.
UNSTEADY NAVIER-STOKES METHOD FOR ACCELERATED MOVING AIRFOILS WITH SEPARATION [INSTATIONAERES NAVIER-STOKES-VERFAHEN FUER BESCHLEUNIGT BEWEGTE PROFILE MIT ABLOESUNG]
Wolfgang Geissler 17 Jan. 1992 71 p In GERMAN
(DLR-FB-92-03; ETN-93-91933) Avail: CASI HC A04/MF A01; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

A method to calculate unsteady viscous flows with separation is presented. These flows are of increasing concern in different areas of application such as vortex separation (dynamic stall) on a retreating helicopter rotor blade or the buffeting problem for elastic wings at transonic flows. In many cases, these phenomena limit the flight envelope of the aircraft. Improved numerical methods based on the Reynolds averaged Navier-Stokes equations in connection with now available supercomputers enable a succesful investigation of the complicated flows involved. The method is applied to problems of accelerated moving airfoils (harmonic ramp motion). Comparisons with available experimental data are discussed. ESA

N93-21766# Midwest Research Inst., Golden, CO.
COMBINED EXPERIMENT, PHASE 1
C. P. Butterfield, W. P. Musial, and D. A. Simms Oct. 1992 220 p
(Contract DE-AC02-83CH-10093)
(DE93-000012; NREL/TP-257-4655-Phase-1) Avail: CASI HC A10/MF A03

How does wind tunnel airfoil data differ from the airfoil performance on an operating horizontal axis wind turbine (HAWT)? The National Renewable Energy laboratory has been conducting a comprehensive test program focused on answering this question and understanding the basic fluid mechanics of rotating HAWT stall aerodynamics. The basic approach was to instrument a wind rotor, using an airfoil that was well documented by wind tunnel tests, and measure operating pressure distributions on the rotating blade. Based on the integrated values of the pressure data, airfoil performance coefficients were obtained, and comparisons were made between the rotating data and the wind tunnel data. Care was taken to note the aerodynamic and geometric differences between the rotating and the wind tunnel models. This is the first of two reports describing the Combined Experiment Program and its results. This Phase 1 report covers background information such as test setup and instrumentation. It also includes wind tunnel test results and roughness testing. DOE

N93-21796# Federal Aviation Administration, Cambridge, MA.
PROCEEDINGS OF THE AIRCRAFT WAKE VORTICES CONFERENCE, VOLUME 1 Final Report
J. N. Hallock Jun. 1992 522 p Conference held at the Quality Hotel Capitol Hill, Washington, DC, 29-31 Oct. 1991 Sponsored by FAA, Washington, DC
(PB93-126449; DOT/VNTSC-FAA-92-7-Vol-1) Avail: CASI HC A22/MF A04

The volume contains the proceedings of the international conference of Aircraft Wake Vortices held at the Quality Hotel Capitol Hill, Washington, DC, on 29-31 Oct. 1991. The contributed papers discuss technological advances in the knowledge of the phenomenon, its effect on aircraft and airport capacity, detection techniques, and vortex avoidance schemes. GRA

N93-20686# Academy of Sciences (USSR), Novosibirsk.
ON THE DISTURBANCES DEVELOPMENT IN THE SUPERSONIC BOUNDARY LAYER
S. A. Gaponov *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 456-457 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20687# Academy of Sciences (USSR), Novosibirsk.
STABILITY AND TRANSITION OF HYPERSONIC BOUNDARY LAYER
V. I. Lysenko *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 458-459 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N93-20928# Construcciones Aeronauticas S.A., Madrid (Spain). Direccion Proyectos.
NONDESTRUCTIVE INSPECTION OF IN-SERVICE AIRCRAFT [INSPECCION NO DESTRUCTIVA DE AVIONES EN SERVICIO]
V. Cortes, Y. DeFrutos, M. Tejo, and F. Fernandez 1992 9 p In SPANISH Presented at the 7th Congresso Espanol y 1st Pirenaico de Ensayos No Destructivos
(ETN-93-93059) Avail: CASI HC A02/MF A01

The rules and the standard procedures established for nondestructive aircraft inspections are summarized. International organizations and aircraft industries produced a users guide to perform inspections. Nondestructive tests are used as a tool to ensure aircraft structure reliability and prevent

in-service failures. The critical aircraft structures to be submitted to nondestructive test are defined on the basis of stress analysis, in-service and evaluation tests. The detection of crack initiation and the crack tolerated length are discussed. The choice of nondestructive test method, and the selection and qualification of the personnel to perform the tests are studied. The aircraft quality control also depends on reports concerning malfunctions or problems detected over noncritical structures. It is recommended that such reports be included in the damage assessment and aircraft safety control procedures. ESA

N93-21187# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Avionics Panel.
MISSION PLANNING SYSTEMS FOR TACTICAL AIRCRAFT (PRE-FLIGHT AND IN-FLIGHT) [SYSTEMES DE PLANIFICATION DES MISSIONS POUR AVIONS TACTIQUES (AVANT VOL ET EN VOL)]
Dec. 1992 62 p
(AGARD-AR-313; ISBN-92-835-0697-9) Copyright Avail: CASI HC A04/MF A01

AGARD Joint-Working Group 15 was established to review mission planning systems and to consider how they are likely to evolve in the future. Its terms of reference specified a program of two phases and the work carried out in the first of these was previously published as AGARD Advisory Report 296. This report covers the work of phase 2. The principle objective of the phase 2 studies was to investigate in detail the distributed mission planning process, dynamic prediction of battle evolution, interoperability, airborne mission planning, mission rehearsal, data filtering/fusion, data protection, communication, testing/validation, artificial intelligence, computer graphics, system architectures, and man/system design. The principle objective was also to assess how these would develop in the future and how such developments would impact upon future mission planning systems. An additional task was to recommend any research and development programs which were identified as being important to future improvements in mission planning systems. Derived from text

N93-21557# Federal Aviation Administration, Atlantic City, NJ.
A MODEL STUDY OF THE AIRCRAFT CABIN ENVIRONMENT RESULTING FROM IN-FLIGHT FIRES Final Report
B. J. McCaffrey (Maryland Univ., Baltimore.), King-Mon Tu (National Bureau of Standards, Washington, DC.), W. J. Rinkinen (National Bureau of Standards, Washington, DC.), and T. I. Eklund Nov. 1992 126 p
(DOT/FAA/CT-90/22) Avail: CASI HC A07/MF A02

A series of tests were conducted to examine the effect of the ventilation on the environment in an aircraft passenger cabin during an in-flight fire. These tests were run in a reduced scale mockup of an aircraft passenger cabin. A propane burner operating at 10 or 30 kilowatts served as the fire source. The simulated seats and the cabin lining material were both noncombustible. The vertical temperature and gas concentration profiles in the cabin were measured as a function of time. Reversing the normal ventilation flow direction by introducing the forced air at the floor level and exhausting it at the ceiling significantly reduced the measured temperatures and gas concentrations. Opening two 152- by 305-millimeter hatches in the end walls at the ceiling level to the outside air resulted in a significant reduction in the measured gas concentrations. Author

N93-21561# Wichita State Univ., KS. National Inst. for Aviation Research.
AIRLINE QUALITY ISSUES 1992: PROCEEDINGS OF THE INTERNATIONAL FORUM ON AIRLINE QUALITY
Dean E. Headley, ed. and Brent D. Bowen, ed. Mar. 1992 297 p Conference held in Washington, DC, 6-7 Mar. 1992
(NIAR-92-10) Avail: CASI HC A13/MF A03

Proceedings of the International Forum on Airline Quality are included. Topics covered include: airline quality ratings; airline quality; airline quality perspectives; and concerns regarding airline quality. Author (revised)

N93-21821# Federal Aviation Administration, Atlantic City, NJ.
THE EFFECTIVENESS OF HAND-HELD FIRE EXTINGUISHERS ON CARGO CONTAINER FIRES
Leroy Dickerson and David Blake Feb. 1993 21 p
(DOT/FAA/CT-TN92/42) Avail: CASI HC A03/MF A01

The purpose of this project was to determine the effectiveness of firefighter intervention using hand-held fire extinguishers on fires in 150- and 800-cubic-foot cargo containers. This test plan was undertaken following a fire in the main deck cargo compartment of a South African Airlines Boeing 747-244B (COMBI) on November 27, 1987. The airplane crashed into the Indian Ocean killing all occupants. A total of 27 tests were performed; 23 in the 150-cubic-foot cargo container series, and 4 in the 800-cubic-foot cargo container series. Three agents were tested--Halon 1211, Halon 1301, and 'loaded stream' water. Only the Halon 1211 agent was partially successful in extinguishing this type of Class A fire. Seven of the 23 fires were extinguished. The rigid cargo containers contained and controlled the test fires through oxygen starvation in 18 of 20 fire tests that were not extinguished. Author

N93-21856# Federal Aviation Administration, Atlantic City, NJ.
PROCEEDINGS OF THE FIRST INTERNATIONAL SYMPOSIUM ON EXPLOSIVE DETECTION TECHNOLOGY Final Report
Siraj M. Khan, ed. May 1992 975 p Symposium held in Atlantic City, NJ, 13-15 Nov. 1991
(DOT/FAA/CT-92/11) Avail: CASI HC A99/MF A10

This report contains opening remarks, kickoff address and keynote address, and 89 papers presented at the First International Symposium on Explosive Detection Technology held 13-15 November 1991, in Atlantic City. The papers deal with the outlook of civil aviation security policy makers in the United States, the United Kingdom, and France and a general introduction to the subject of explosive detection technology. These are followed by papers on physical techniques for explosive detection, chemical and biological techniques for explosive vapor detection, tagging, signal processing and simulation, and testing and field experience. This compendium of useful and practical information was prepared for program managers, scientists, and engineers engaged in research, development, test, and evaluation (RDT&E) in the critical area of global aviation security. For individual titles, see N93-21857 through N93-21945.

N93-21857# Eurotunnel, London (England).
ROLE OF ADVANCED TECHNOLOGY IN THE SECURITY OF SURFACE TRANSPORTATION
Bernard B. Boubli *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 13-18 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

A speech made by the Head of Security for Eurotunnel is presented. The speech is primarily concerned with the application of advanced technology (AT) to the problems of security in the context of surface, as opposed to airborne transportation. The speech is composed of seven parts: (1) preamble; (2) security--the uninvited guest; (3) roots of the European terrorist threat; (4) the regulatory framework; (5) the technological dimension; (6) the human factor; and (7) the financial hurdle. CASI

N93-21858# Department of Transport (England). Transport Security Div.
THE UK PERSPECTIVE ON AVIATION SECURITY
Richard H. Doney *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 19-20 (For primary document see N93-21856 07-03)
Avail: CASI HC A01/MF A10

This presentation summary is divided into two parts. The first sets out the views of the UK government on aviation security in general and identifies the major thrusts of its policy. The second part describes how that perspective affects our attitude toward technology. It discusses a number of questions which will have to be satisfactorily answered before we can come to place reliance on explosive detection systems. Author

N93-21859# Federal Bureau of Investigation Academy, Quantico, VA. Bomb Data Center.
INSIGHTS INTO US DOMESTIC AVIATION
Richard Redman *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 21-22 (For primary document see N93-21856 07-03)
Avail: CASI HC A01/MF A10

The vulnerability of the United States to terrorist attack on its civil aviation infrastructure--aircraft and airports--is discussed. It is argued that perceived successes against the threat of skyjacking have lulled American civil aviation security forces into complacency. As a result of this, an

inadequate amount of attention is being placed on passengers and their carry-on baggage, when in the author's opinion it should be placed on the luggage going into the aircraft's baggage-hold. CASI

N93-21860# Air France, Paris.
ROLE OF ADVANCED TECHNOLOGY WITHIN A BROAD SECURITY APPROACH
Pascal Morvan *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 23-25 (For primary document see N93-21856 07-03)
Avail: CASI HC A01/MF A10

Detection methods based on a particular type of threat are discussed. Three cases are considered: (1) detection of residue or vapor; (2) detection of bulk explosive; and (3) detection of ignition components.
Derived from text

N93-21861# Science Applications International Corp., Santa Clara, CA.
PRINCIPLES OF NUCLEAR-BASED EXPLOSIVE DETECTION SYSTEMS
Tsahi Gozani *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 27-55 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

This paper reviews the multitude of possible nuclear techniques for explosive detection. From this wide selection, some feasible and a few practical techniques, which can comply with the tough operational requirements, are emerging. The paper describes the requirements for explosive detection sensors and the reasons why nuclear techniques are uniquely responsive to these requirements. The 'nuclear' (i.e., elemental) signatures of explosives, available nuclear reactions, and other nuclear scientific considerations are discussed and demonstrated with the aid of results from sensors or systems which are in advanced stages of R&D or fully deployed. Derived from text

N93-21862# Westinghouse Science and Technology Center, Pittsburgh, PA.
A REVIEW OF THE DEVELOPMENT OF A LUGGAGE EXPLOSIVE DETECTION SYSTEM
J. Bartko and F. H. Ruddy *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 56-65 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

Based on the favorable results of laboratory tests, the FAA initiated a follow-on program to examine real baggage. For this a detection system was designed and constructed in a trailer. The trailer was transported to four different airports and tests were conducted on a sizeable number of baggage or cargo items. The FAA would add simulated explosives to selected items to provide information on detection rates and false alarm rates. The results of the last two tests are shown. The result pointed to the feasibility of moving to the prototype stage. As a result of the Westinghouse development program, TNA explosive detectors are beginning to play an important role in airport security. Presently, these are four TNA systems established at airports and three others are planned. Improvements vis-a-vis detection of plastic explosives continue to be made.
Derived from text

N93-21863# United Kingdom Atomic Energy Authority, Harwell (England). Industrial Technology Branch.
A TRANSPORTABLE LUGGAGE EXAMINATION SYSTEM BASED ON NEUTRON INTERROGATION
Duncan Brian Syme and Gregory D. James *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 66-69 Sponsored by Ministry of Transport (For primary document see N93-21856 07-03)
Avail: CASI HC A01/MF A10

A transportable TNA system suitable for the analysis of passenger luggage was designed, built, and tested on airport luggage. The response of the system to passenger luggage and to luggage containing explosive simulant has enabled the detection performance of the system to be determined. The system uses a distribution of low strength Cf-252 sources and an array of gamma-ray detectors bordering the luggage cavity. This arrangement gives positional information for bulk simulant but is otherwise equally sensitive to bulk and sheet simulant. The system weighs 1.7 tons and can be assembled in about one hour from components weighing less than 30 kg each. The radiological dose close to the analyzer is less than 1.5 micro-Sv/h. Used in conjunction with an X-ray analyzer, the combined system would have low false alarm rate (FAR) and high detection performance. Derived from text

N93-21864# Science Applications International Corp., San Diego, CA.
AN APPROACH TO IMPROVING TNA EDS
Steven Bruce Buchsbaum, Duane Joseph Knize, Leon Feinstein (Science Applications International Corp., Los Altos, CA.), Joseph Bendahan (Science Applications International Corp., Los Altos, CA.), and Patrick Shea (Science Applications International Corp., Santa Clara, CA.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 70-81 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

The purpose of this internally funded study was to develop a set of specific recommendations for signal processing changes, and system enhancements, to improve the TNA EDS performance, particularly to reduce false alarms, and to develop a full system simulation capable of predicting system performance against various threats. The simulation would be based upon threat specifications, clutter databases, and present and future design parameters. Derived from text

N93-21865# Science Applications International Corp., Santa Clara, CA.
PFNA TECHNIQUE FOR THE DETECTION OF EXPLOSIVES
Zdzislaw P. Sawa and Tsahi Gozani *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 82-103 (For primary document see N93-21856 07-03)
(Contract DTFA03-87-C-00043)
Avail: CASI HC A03/MF A10

Techniques for detecting chemical explosives in passenger luggage must be capable of unequivocally and rapidly identifying the threat in the luggage, with a negligible rate of false alarms. This can be achieved by using nuclear radiations for a non-intrusive measurement of the chemical composition, including mapping of elements of the contents of luggage. Nuclear techniques have been used for a long time to measure chemical compositions. This paper describes a method of detecting explosives, based on the gamma-ray spectrometry in inelastic scattering of pulsed fast neutrons. This interaction leads to excitation of low-lying energy states of nuclei of all the elements of importance in explosives. Derived from text

N93-21866# University of Western Kentucky, Bowling Green. Dept. of Physics and Astronomy.
A PULSED FAST-THERMAL NEUTRON INTERROGATION SYSTEM
George Vourvopoulos, F. J. Schultz (Oak Ridge National Lab., TN.), and J. Kehayias (Tufts Univ., Boston, MA.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 104-115 (For primary document see N93-21856 07-03)
(Contract DE-AC05-84OR-21400)
Avail: CASI HC A03/MF A10

Among the various analytical methods that could be used for the detection of explosives, a nuclear technique (thermal neutron activation analysis) was the first to show, in a practical way, the ability to detect small amounts of hidden explosives. Given the fact that there are materials such as melamine equally rich or richer in N than the known explosives, the detection of N was shown to be inadequate in uniquely identifying an explosive. In particular, it was shown that all explosives have a unique O-N profile. By determining the amount of these two elements contained in the interrogated material, the identification of hidden explosives would become more certain. C would be the third element that is common in all the explosives although it does not correlate uniquely with all known explosives. A system therefore that would be able to identify and quantify all three elements, C, N, and O would be able to provide more reliable information about the interrogated material. Among the various options for the C, N, O identification, a pulsed fast-thermal neutron interrogation system is the technique that we utilize. In the following sections we present the advantages of the method, describe the characteristics of the various nuclear reactions, and present the data demonstrating the elemental identification.
Derived from text

N93-21867# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Physics.
THE NITROGEN CAMERA: A NEW EXPLOSIVE DETECTOR
W. Peter Trower *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 116-122 Sponsored in cooperation with the Swedish Technical Development Board (For primary document see N93-21856 07-03)
(Contracts DAAK70-91-C-0034; DAAK70-92-C-0001)
Avail: CASI HC A02/MF A10

The Nitrogen Camera has much in common with conventional cameras--photographic, x-ray, and positron--but, it makes use of a different physics. In the photographic camera, visible light with energy of a few eV is scattered by an object, is manipulated by a variety of optical devices, falls onto an aperture, and is recorded on an electronic or chemical media. The x-ray camera uses photons of a few keV, which are scattered as they pass through an object, fall unmanipulated onto an aperture, and are recorded. In the PET camera, a radioisotope, with a half-life of hours to days, is injected into an object. Decay positrons of a few MeV lose energy by a succession of bremsstrahlung collisions, finally annihilating into two oppositely-directed gamma rays, the signals from which are manipulated to produce three-dimensional images. Author

N93-21868# Environmental Research Inst. of Michigan, Ann Arbor.
NEUTRON ELASTIC SCATTER (NES) FOR EXPLOSIVES DETECTION SYSTEMS (EDS)
Henry Jacob Gomberg and Brian G. Kushner (BDM International, Inc., Arlington, VA.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 123-139 Prepared in cooperation with Ann Arbor Nuclear, Inc., MI (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

PENETRON, Inc. was created in 1987 as a joint venture between the Environmental Research Institute of Michigan (ERIM) and Ann Arbor Nuclear, Inc., for development of new, innovative search systems for detection and location of contraband such as hidden explosives, and subsequently, concealed narcotics. The NES system concept described below resulted from the initial joint venture for explosives detection. The initial analytical work, which ran for about a year within Ann Arbor Nuclear but in close collaboration with ERIM, was followed by formation of PENETRON as a joint venture and the initiation of an experimental testing and verification program. The experiments were carried out at the Nuclear Physics Research Laboratory of the University of Kentucky at Lexington. Those studies form the base from which the DBM-PENETRON team is moving towards prototype systems for demonstration and toward production of fieldable systems. Author

N93-21869# Science Applications International Corp., Santa Clara, CA.
DETECTOR SELECTION FOR NUCLEAR-BASED EXPLOSIVE DETECTION SYSTEM
Willis Lee, Joseph Bendahan, Peter Ryge, and Tsahi Gozani *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 140-150 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

The gamma ray scintillators form the basic detection system for three nuclear-based explosive detection systems, namely the thermal neutron analysis (TNA), fast neutron analysis (FNA), and pulsed fast neutron analysis (PFNA). These scintillators are required to distinguish gamma ray lines of interest from a background that is composed of non-explosive materials as well as the detector material itself. The gamma ray of interest in the case of TNA is the 10.83 MeV thermal neutron capture line from nitrogen. The lines of interest in FNA and PFNA are the 6.13 and 4.43 MeV lines from inelastic scattering of fast neutrons in oxygen and carbon, respectively, among others. Various types of scintillators were evaluated. The list included thallium activated sodium iodide (NaI(Tl)), bismuth germanate (Bi4Ge3O12, also known as BGO), and barium fluoride (BaF2). Derived from text

N93-21870# Science Applications International Corp., Santa Clara, CA.
EXPLOSIVE DETECTION SYSTEM BASED ON ELECTRONIC NEUTRON GENERATOR (ENG)
Willis Lee, David B. Mahood, Peter Ryge, Joseph Bendahan, and Tsahi Gozani *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 151-159 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

Under FAA sponsorship, thermal neutron analysis (TNA) explosive detection systems (EDS) for inspection of checked airline baggage were developed and demonstrated. Two parallel development paths were initiated, one using a californium-252 radioisotope source and one using an electronic neutron generator (ENG) consisting of a small particle accelerator with a neutron production target. A second generation development produced the californium-based TNA presently deployed in various airports. Each of these neutron sources has its advantages over the other. The Kaman A711 was the least costly neutron generator capable of providing the necessary neutron flux and was therefore selected for the ENG-EDS development. A prototype EDS using it was designed, constructed, and evaluated. Derived from text

N93-21871# EG and G Energy Measurements, Inc., Santa Barbara, CA. Special Technologies Lab.
ASSOCIATED PARTICLE IMAGING
Albert C. Beyerle, Robin K. Durkee, Garrett Headley, J. Paul Hurley, and Laura Tunnell *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 160-174 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

An associated particle imaging (API) system was built and some first images recorded. These images are presented in this paper. Design of the system was reported previously. Derived from text

N93-21872# AccSys Technology, Inc., Pleasanton, CA.
THE RFQ LINAC: A HIGH-CURRENT COMPACT ION ACCELERATOR FOR EXPLOSIVE DETECTION
Robert W. Hamm *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 175-183 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

The radio-frequency quadrupole linear accelerator (RFQ linac) is well-suited for use in the detection of explosives. As a proven, commercially available ion accelerator, the RFQ linac has no equal in the generation of high-current, high-quality beams. The flexibility of the RFQ and the implementation options available enhance its ability to be the most appropriate accelerator available for several of the proposed nuclear detection techniques. Its compact size, high current capability, and ease of operation and maintenance have already made the RFQ the accelerator selected for several new systems under development. Derived from text

N93-21873# Grumman Aerospace Corp., Princeton, NJ. Space Systems Div.
DESIGN OF A HIGH CURRENT PROTON ACCELERATOR
A. M. M. Todd, C. C. Paulson, J. W. Rathke, M. F. Reusch, O. A. Anderson (California Univ., Berkeley. Lawrence Berkeley Lab.), and K.-N. Leung (California Univ., Berkeley. Lawrence Berkeley Lab.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 184-196 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

This paper principally addresses the physics design, to nominal performance criteria, of the accelerator system which produces the 1.76 MeV proton beam incident on the C-13 target system. Electrical, radio-frequency (RF), thermal, vacuum and mechanical design of the various components, which are shown schematically, were also performed. Target and resonance or non-resonant scintillator detector issues are not discussed here. The resonance absorption EDS requires that the accelerator meet the qualitative performance goals identified. An approach to solving these issues is identified and discussed in greater detail below. Derived from text

N93-21874# Tri-Univ. Meson Facility, Vancouver (British Columbia).
AN H(-) ION SOURCE FOR RESONANT GAMMA PRODUCTION
Paul W. Schmor and Lothar Rainer Buchmann *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 197-199 (For primary document see N93-21856 07-03)
Avail: CASI HC A01/MF A10

A nitrogen detection system for explosives requires an H(-) ion source

with a current of at least 5 mA dc within a normalized rms emittance of 0.09 pi mm-mrad. These specifications are met by a multi-cusp ion source and ion extraction system which was developed at TRIUMF. This ion source is being used on a cyclotron for the commercial production of radio isotopes. The cyclotron has been in operation for slightly more than one year. During this period the ion source has operated without problem, requiring only regularly scheduled filament changes. Some of the important criteria for the ion source in this application include: (1) current stability; (2) reliability; (3) ease of operation; (4) reproducibility; and (5) minimal maintenance requirements. All of these features are needed for a practical explosives detector. Derived from text

N93-21875# Massachusetts Inst. of Tech., Cambridge.
PHOTONS IN - PHOTONS OUT: NON-DESTRUCTIVE INSPECTION OF CONTAINERS USING X RAY AND GAMMA RAY TECHNIQUES
Lee Grodzins *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 201-231 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

The paper begins with a discussion of the physical properties that distinguish an explosive. We then consider x-ray techniques, including simple transmission, Compton backscatter, multiple energy, and multiple view. We omit coherent scattering and detonator detection. We then take up Mev x-ray imaging for investigating large containers, which leads into the use of Mev x-rays for nuclear resonance absorption, a new technique not previously discussed. Recent progress in the Soreq technique of nuclear resonance absorption is then summarized. The final section suggests a gauntlet of different EDD x-ray machines, that either are or will be available soon, which together with profiling and hand searches could, I believe, be a formidible deterrent against terrorists. Derived from text

N93-21876# Nottingham Univ. (England).
THREE DIMENSIONAL X RAY SYSTEMS AND IMAGE ENHANCEMENT TECHNIQUES
Max Robinson and Paul Evans *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 232-236 Sponsored by UK Department of Transport and the Home Office (For primary document see N93-21856 07-03)
Avail: CASI HC A01/MF A10

X-ray images are by their very nature difficult to understand. Interpretation of these images is based solely on shape and grey shade information. For most security applications these images are presented on standard video monitors. Not only do the images usually contain no information concerning 3-D space they are often presented in ways that have paid little heed to the psychology of the human visual system. Two distinctly different developments are considered in this paper both of which provide x-ray information in ways which make human interpretation an easier task. Author

N93-21877# Titan Technologies, Albuquerque, NM. Spectron Div.
AN EXPLOSIVE DETECTION SYSTEM FOR SCREENING LUGGAGE WITH HIGH ENERGY X RAYS
Jerome R. Clifford, R. Bruce Miller, William F. McCullough, and Kerry W. Habiger *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 237-251 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

This paper focuses on the EXDEP technique and the experimental results which show the capability to detect explosives, to image the explosives, and to discriminate explosives from other materials. The accompanying paper, 'Explosive Detection for Checked Luggage by DETEX, a Combined X-ray and Positron-Tomography System,' presents details on an EXDEP-based explosives detection system and shows simulation results for detection of sheet explosives using a combination of EXDEP and standard x-ray. Derived from text

N93-21878# Lawrence Livermore National Lab., CA. Nondestructive Evaluation Section.
EXPLOSIVES DETECTION LIMITATIONS USING DUAL-ENERGY RADIOGRAPHY AND COMPUTED TOMOGRAPHY
Kenneth W. Dolan, R. W. Ryon, D. J. Schneberk, H. E. Martz, and R. D. Rikard *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 252-260 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

Computed tomography (CT) provides volumetric mapping of x-ray attenuation in objects. X-ray attenuation is a function of composition and density. By making measurements at two or more energies, density and 'average composition' (or effective atomic number) can be separated. Dual energy CT was therefore suggested as a means for positive identification of small explosive quantities in baggage, boxes, containers, etc. We have used the dual energy CT method successfully to determine density and effective atomic number of explosives and mock material with accuracies of a few percent on density and better than +/- 1 atomic number. Our dual energy CT work was done in a materials analysis context. Two methods were used: (1) isotope sources, which emit discrete energy (monochromatic) x-rays, coupled with energy discriminating x-ray detectors; and (2) X-ray tube sources, which emit a continuum (bremsstrahlung) energy distribution of x-rays, coupled with nondiscriminating detectors. We have developed beam hardening correction procedures for CT with polychromatic x-ray tube spectra. Dual energy CT with polychromatic sources is implemented by any technique that modifies the x-ray spectrum at either the source or the detector. This is accomplished by using two accelerating potentials, beam filtration before or after the sample, or energy selective detectors. The polychromatic option provides high flux source intensities which would be needed for routine high throughput explosives detection. We have also used transmission anode x-ray tubes, which produce nearly monochromatic radiation, for x-ray gauging. Such tubes may be useful for baggage inspection CT. Derived from text

N93-21879# IRT Corp., San Diego, CA.
DETECTION OF OBJECTS CONCEALED UNDER PERSONS' CLOTHING USING THE SECURE SYSTEM
Steven W. Smith *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 261-268 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

The problem of detecting weapons and contraband concealed under the clothing is very old. Airline hijackings in the 1970's focused the problem on detection of metal firearms and knives. The technological challenge of the 1990's, and beyond, will be detection of non-metallic weapons, explosives, and illegal drugs. While metal detectors and chemical sniffers may be used for the detection of larger metal objects and certain chemical substances, no system is currently available that can detect a wide variety of concealed objects and materials. Security personnel have little option but to hand search persons suspected of concealing many kinds of threats. The operating principles and test results of a new technique developed to address this need is described. Derived from text

N93-21880# American Science and Engineering, Inc., Cambridge, MA.
NEW X RAY TECHNOLOGY FOR THE DETECTION OF EXPLOSIVES
David A. Schafer, M. Annis, and M. Hacker *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 269-281 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

Traditional x ray transmission systems are not well suited to detection of low Z threats such as plastic explosives. Several different approaches have been implemented, such as backscatter and dual energy, to use x ray imaging to detect these threats. The physical principles of x ray interactions are used to interpret the results and to deduce the types of materials present in the luggage. These x ray technologies are sensitive to the overall density and atomic number of the constituents and since plastic explosives are typically characterized by low atomic number (low Z) and high density (relative to other low Z materials), these techniques can be effective in locating explosive threats in many situations. In an attempt to improve on the detection capabilities of the AS&E Model 101Z, a new approach, based on forward scattering, was investigated at AS&E. The physical background for this technology as well as some preliminary results of this investigation are presented. Author

N93-21881# Vivid Technologies, Inc., Waltham, MA.
ADVANCED DUAL ENERGY X RAY FOR EXPLOSIVES DETECTION
Kristoph D. Krug and Jay A. Stein *In* FAA, Proceedings of the First

International Symposium on Explosive Detection Technology May 1992 p 282-284 (For primary document see N93-21856 07-03)
Avail: CASI HC A01/MF A10

The Vivid Rapid Explosives Detection System is a precision materials analysis instrument designed to automatically inspect airport baggage for the presence of explosive materials. The unit also features a high quality image and many imaging enhancements to aid human operators in baggage inspection and in visually clearing false alarms. The system is designed to physically resemble imaging-only x-ray machines now in place in airports around the world and is able to be used in any location where a conventional x-ray machine is currently installed. Derived from text

N93-21882# Science Applications International Corp., San Diego, CA.
THREE-DIMENSIONAL X RAY IMAGING FOR THE DETECTION OF CONTRABAND
D. C. Shreve, R. Schirato, R. Polichar, and Victor John Orphan *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 285-296 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

Standard transmission radiography is used in many types of inspections. Radiography allows the examination of the interiors of objects. X-ray images yield information about the shape and density of the items inside of an object. One potential problem with transmission radiography for the detection of explosives is the difficulty in image interpretation when dense items obscure or confuse the observation of lower density objects. Our experience has shown that this can certainly be the case when one desires to detect explosives on the interior of containers which also contain metallic objects. The clutter caused by overlapping objects can be a serious problem in image interpretation. X-ray laminography, a 3-dimensional inspection technique that can reduce the problems caused by overlapping objects in normal transmission x-radiography, is described. An example of the technique will be presented. Derived from text

N93-21883# Imatron Federal Systems, Inc. Burke, VA.
THE EVOLUTION OF COMPUTED TOMOGRAPHY (CT) AS AN EXPLOSIVES DETECTION MODALITY
Fredrick L. Roder *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 297-308 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

There was a revolution in diagnostic radiology in 1972 - Godfrey Hounsfield announced the development of the world's first computed tomographic (CT) scanner. For the first time, radiologists did not have to decipher the vague x-ray shadows which spelled the difference between normal anatomy and ominous tumors. The scanner allowed organs to be seen directly and individually, just as they would have appeared to a surgeon, had a biopsy been necessary. For CT explosives detection to be practical, a scanner would have to: (1) have a physical and image aperture of sufficient size to accommodate large luggage; (2) rapidly acquire image data; (3) rapidly reconstruct these data into cross-sectional images; (4) produce images with sufficient resolution to allow the automated detection of sheet explosive; and (5) perform these functions continuously, over extended time periods. The progress made toward each of these goals, culminating in the current development of the CTX Explosives Detection System is described. The tests to date which have demonstrated the efficacy of this technique are discussed and the manner in which a CTX system will be used in an airport is extrapolated. Derived from text

N93-21884# Edgerton, Germeshausen and Grier, Inc., Long Beach, CA. Astrophysics Div.
EXPLOSIVE DETECTION USING X RAYS AND THERMAL NEUTRON ACTIVATION
T. R. Wang, P. J. Bjorkholm, Richard Scarlet (Edgerton, Germeshausen and Grier, Inc., Waltham, MA.), and S. Goldberg (Edgerton, Germeshausen and Grier, Inc., Salem, MA.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 309-310 (For primary document see N93-21856 07-03)
(Contract DFTA03-91-C-00041)
Avail: CASI HC A01/MF A10

For the last fifteen years, EG&G Astrophysics has been actively involved in research, development, and implementation of various weapon and explosive detection systems which can be used in airports, government facilities, and other institutions for overall security. Since the Pan-Am 103 accident in 1989, there has been heightened concern from the public, Congress, and the FAA regarding aviation security. One of the biggest concerns has been the potential threat from plastic explosives. EG&G Astrophysics has developed an explosive detection system that uses a dual view dual energy (DVDE) x-ray system. In conjunction with the FAA, EG&G is continuing its own development of DVDE in combination with thermal neutron analysis (TNA) to identify both metallic weapons and plastic explosives in baggage. This approach allows the analysis to fully utilize data sets from DVDE and TNA to their best potential, and to objectively define tradeoffs among the costs and performances of the differing sensors. Derived from text

N93-21885# Science Applications International Corp., Santa Clara, CA.
FUSION OF THE NUCLEAR AND DIFFERENT X RAY TECHNOLOGIES FOR EXPLOSIVES DETECTION
V. Leung, Patrick Shea, F. Liu, and M. Sivakumar *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 311-318 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

Explosive Detection Systems (EDS) are to be used in airports to detect explosives concealed in baggage. They have an important role in the security system protecting human life and property from being destroyed by acts of terrorism. Among the existing explosive detection techniques, the one which can achieve the highest total sensitivity to nitrogen is the Thermal Neutron Activation (TNA) technology. The TNA-EDS, designed and developed by Science Application International Corporation (SAIC), is able to detect explosives with high probability of detection (PD) and an operationally acceptable probability of false alarm (PFA). False alarms impede the baggage circulation processes because of the need to further screen them. In order to decrease the PFA, a secondary inspection system has been added to the TNA-EDS. X-Ray radiography, which measures the densities of objects in suitcases with high spatial resolution, has proven to be a good secondary inspection unit to the TNA-EDS in reducing the PFA. The fusion of the most prominent pieces of information from both the TNA and the x-ray reinforces the EDS ability to identify the presence of explosives in suitcases more accurately. This combined system, the X-ray Enhanced Neutron Interrogation System (XENIS), was designed and developed by SAIC using the Astrophysics X-Ray Transmission Linescan System, and is currently used by the U.S. Federal Aviation Administration (FAA) in several airports in the U.S. and Europe. The basic principles of the XENIS and the complex data analysis and automated decision algorithms developed by SAIC for the realization of this technology is described. It also discusses the issues involved in the practical application of the XENIS in airports. Two new x-ray techniques were investigated for the future upgrade of the XENIS. They are the X-Ray Transmission Computed Tomographic (CT) Scanning technique built by Imatron, Inc. and the X-Ray Transmission and Backscatter Tomographic (ZT) Scanning technique built by American Science and Engineering (AS&E). Both techniques were investigated by SAIC and tested by the FAA, and are described. Derived from text

N93-21886# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).
EXPLOSIVE DETECTION FOR CHECKED LUGGAGE BY DETEX, A COMBINED X RAY AND POSITRON-TOMOGRAPH SYSTEM
Hans Wolfgang Pongratz *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 319-332 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

The DETEX-System (DETection of EXplosives) is a multistage, automatic detection system for explosives in checked luggage on airports. The operating principle of DETEX combines a two energy x-ray machine performing three-dimensional reconstruction and a bremsstrahlungs source with a positron tomograph system and automatic threat assessment algorithms. Special reconstruction algorithms for the positron tomograph were developed for three-dimensional reconstruction of activity distribution at low count rates. Results of simulations and measurements are presented and discussed. Author (revised)

N93-21887# Southwest Research Inst., San Antonio, TX. Instrumentation and Space Research Div.

SELECTIVE GAMMA RAY RESONANT ABSORPTION FOR EXPLOSIVES DETECTION

Colin Nicholls, J. Derwin King, and Floyd D. McDaniel (North Texas State Univ., Denton.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 333-345 (For primary document see N93-21856 07-03)

Avail: CASI HC A03/MF A10

The provision of improved security for passengers in domestic and international travel is a high priority need of the Federal Aviation Administration (FAA) and other government agencies. One technique currently under investigation is based on the resonant absorption in nitrogen of 9.17 MeV gamma rays. Since explosives contain a higher proportion of nitrogen than most common materials, a high nitrogen absorption can be used to infer the presence of explosives. This technique is attractive in that the gamma rays used are of sufficiently high energy that they can penetrate most shielding that could reasonably be incorporated into a suitcase. However, the method is more accurately a nitrogen concentration detector rather than a specific explosive detector and so false alarm rates from this approach could be high. If a degree of chemical selectivity (i.e. detection of explosives, rather than nitrogenous compounds) could be incorporated into the method, then false alarm rates might be reduced to a low enough level to make this a particularly attractive technique. SwRI has identified a promising method to achieve this and has filed for a patent. In this modified method, high energy gamma rays are used to penetrate metal shields while a magnetic field is applied to modulate the nuclear energy levels of selected nuclei (N-14) in the material being tested. This modified resonant gamma ray absorption approach will potentially provide chemical sensitivity and specificity to selected nitrogeneous compounds, including some explosives. Author (revised)

N93-21888# JAN Associates, Inc., Bethesda, MD.

A GENERAL PROTOCOL FOR OPERATIONAL TESTING AND EVALUATION OF BULK EXPLOSIVE DETECTION SYSTEMS

Joseph A. Navarro, Donald A. Becker (National Inst. of Standards and Technology, Rockville, MD.), Bernard T. Kenna (Sandia National Labs., Albuquerque, NM.), and Carl F. Kossack (Kossack, Carl F., Sun City Center, FL.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 347-367 (For primary document see N93-21856 07-03)

Avail: CASI HC A03/MF A10

In March 1990, the FAA Technical Center established a Task Force of independent consultants to undertake testing and evaluation by SAIC at the JFK airport. As a result of its work, the Task Force was asked to prepare a protocol for the conduct of operational testing of explosive detection systems (EDS) for checked or carry-on airline baggage (bags, containers, etc). These results, in part, would also be used to decide on FAA certification of bulk explosive detection systems. This protocol is specific to testing of production hardware, as opposed to R&D brass/bread board models or prototype versions of the system. This protocol is applicable to systems which are automated (i.e., no human intervention used for detection process) and for those systems which do not change the characteristics of the tested item as a result of the item being tested. This protocol is only applicable to systems based on detection of explosives in bags via bulk properties (i.e., vapor detection systems are excluded). Finally, although this protocol was written to be applicable for the detection of explosives in bags, much of it is applicable for the detection of explosive devices.

Derived from text

N93-21889# Police Scientific Development Branch, Saint Albans (England).

PERFORMANCE TESTING OF EXPLOSIVES AND WEAPONS DETECTION SYSTEMS

Timothy George Sheldon, Richard John Lacey, N. C. Murray, and G. M. Smith *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 368-375 (For primary document see N93-21856 07-03)

Avail: CASI HC A02/MF A10

The philosophy and methodology underlying equipment tests carried out by the Home Office Police Scientific Development Branch are described. This organization carries out, among other things, development and testing work on explosives and weapons detection systems on behalf of three main customers: Police Forces, the Prison Service, and the Department of Transport. It describes the steps in planning and carrying out trials and some of the pitfalls to avoid. It refers to past and current evaluations and tests for different types of equipment are outlined. The possibility of standardizing certain tests is also discussed. Derived from text

N93-21890# Science Applications International Corp., Falls Church, VA.

A FRAMEWORK FOR THE OBJECTIVE TEST AND EVALUATION OF EXPLOSIVE DETECTION TECHNOLOGY

Donald R. Greenlee *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 376-380 (For primary document see N93-21856 07-03)

Avail: CASI HC A01/MF A10

The critical need for effective explosive detection capabilities in support of aviation security has stimulated the research and development of a variety of potentially applicable technologies. Prior to any major investment in the acquisition of equipment for actual deployment, however, each candidate technology (or combination thereof) should be subjected to test and evaluation (T&E) in an operationally realistic setting adequate to verify its effectiveness and suitability. A framework for the objective approach to this testing and evaluation should promote test requirements definition, test concept development, test design, technical and operation test planning, test instrumentation and facilities, the role of modeling and simulation in support of test and evaluation, test conduct and monitoring, data collection, reduction, processing and analysis, and assessment of results adequate to determine 'How much testing is enough?', the most difficult question in the relationship between T&E and acquisition of deployment. The cost of test and evaluation, particularly where advanced technology, sophisticated threats, environmental constraints and hazards to safety exist, coupled with inevitable programmatic, political, and schedule pressures on the system under test, create forces tending to minimize the type, amount and duration of testing. Conversely, the need for technical and operational information about the system and its behavior, and for proof by demonstration that the system satisfies the requirements it was developed to meet, gives rise to the desire for maximizing testing and its support functions to accommodate the system's developers, users, and overseers. Since testing per se does not improve the performance of a system, T&E is technically a 'zero value added' process, except for the information it provides. The projected information value of a test in reducing risks in the acquisition/deployment decision process, then, provides a basis for solving the indicated 'minimax' problem. Derived from text

N93-21891# Gamma-Metrics, San Diego, CA.

VALIDATION OF SIMULATED EXPLOSIVES FOR TESTING TNA EXPLOSIVES DETECTION SYSTEMS

Michael J. Hurwitz and Wilbert P. Noronha *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 381-387 (For primary document see N93-21856 07-03)

Avail: CASI HC A02/MF A10

GAMMA-METRICS has developed an explosives detection system (EDS) for airline checked baggage. This system is based upon prompt gamma neutron activation analysis, (PGNAA), often referred to as thermal neutron analysis. In the development and testing of such systems it would be normal to place the target materials in the system in order to obtain realistic signals and to measure the performance. However, explosives are highly regulated materials and special licenses and permits are required for their handling and storage. In fact we have been unable to obtain a permit to store explosives in our facility. We are now also engaged in airport testing of our EDS. This also requires a suitable target but it is difficult, if not impossible, to bring real explosives onto the airport where we are performing the tests. The alternative is to create a suitable inert simulated explosive which will produce the same gamma ray signatures that are produced by real explosives. Some common and convenient materials to create simulants for the TNA EDS are chosen and tested.

Derived from text

N93-21892# Gamma-Metrics, San Diego, CA.

AIRPORT TESTING OF A NEW THERMAL NEUTRON ANALYSIS EXPLOSIVES DETECTION SYSTEM

Michael J. Hurwitz, Wilbert P. Noronha, and T. A. Atwell *In* FAA, Proceedings of the First International Symposium on Explosive Detection

Technology May 1992 p 388-395 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

GAMMA-METRICS has developed an explosives detection system (EDS) for airline checked baggage. This system is based upon prompt gamma neutron activation analysis (PGNAA), often referred to as thermal neutron analysis. This system is designed to use a long-lived SODERN electronic neutron generator, but it can also use a californium-252 neutron source. Among the other features of this system are the use of a larger number of detectors and provision for the use of an integrated X-ray system in order to improve the detection versus false alarm performance for smaller explosives. The EDS is made up of 5 modules so that it may be readily assembled in the field. The system is currently deployed in an extensive data collection and testing program in the baggage make-up room of Delta Air Lines at Los Angeles International Airport (LAX). This testing program is being supported under an FAA contract. Derived from text

N93-21893# Science Applications International Corp., Santa Clara, CA.
RADIOLOGICAL SAFETY ASPECTS OF TNA DEPLOYMENT
I. M. Bar-Nir and Peter Ryge *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 396-408 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

Active nuclear interrogation techniques enable non-invasive explosives detection. These techniques use neutrons or high energy gamma rays as probes. They study the products of the interactions of these probes with individual atoms in the inspected object to determine the presence of specific elements characteristic of explosive materials. These active techniques provide highly penetrating probes that generate distinguishable and detectable reaction products from the different elements constituting the various substances present inside the inspected object. Thermal neutron analysis (TNA) is currently the only nuclear technique incorporated in a practical and tested explosive detection system (EDS). The deployment and use of nuclear based devices in areas accessible to the general public (e.g., the concourse of an airport) raise concerns about potential radiation related hazards. A major part of the effort put into the TNA program was to ascertain that its installation and operation are harmless both to personnel and to members of the general public. Section 2 provides a brief description of the technology and how it is implemented. Section 3 describes the safety issues and how they were addressed in the TNA devices. Derived from text

N93-21894# Science Applications International Corp., Santa Clara, CA.
RADIOLOGICAL SAFETY REGULATION AND LICENSING OF NUCLEAR-BASED EXPLOSIVE DETECTION SYSTEMS
Peter Ryge and I. M. Bar-Nir *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 409-414 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

The use of nuclear-based interrogation techniques for non-invasive explosive detection has several marked advantages over competing technologies. They employ neutrons or high energy gamma rays as probes. The safety issues and the general regulatory framework are discussed. Section 3 describes the path that has to be undertaken in the U.S. before one is authorized to install and operate a nuclear facility. Issues such as the responsibilities of the users and the manufacturers and the different regulatory bodies one has to deal with in different circumstances are discussed. Section 4 describes the situation in some foreign countries. The experience from the deployment of TNA systems is used as an example. Author

N93-21895# Science Applications International Corp., Santa Clara, CA.
EXPERIENCE WITH EXPLOSIVE DETECTION SYSTEMS IN AIRPORTS
I. M. Bar-Nir, Russell L. Cole, and D. Sumi *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 415-426 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

The integration of a high tech based Explosives Detection System (EDS) into the airport environment is described. In particular, the operational aspects are emphasized. The pros and cons of different installation scenarios (e.g., lobby versus tarmac) are discussed. Section 2 describes the operational experience of the thermal neutron analysis (TNA) units in the various locations focusing on the installation and summarizing the performance results. Section 3 describes the operational logic of explosive detection in general and its implementation by the TNA. Conclusions are presented in Section 4. In an Appendix, the performance of an EDS in terms of the relationship between its detection capabilities and its alarm rates is discussed. Derived from text

N93-21896# Thermedics, Inc., Woburn, MA.
SAMPLING EXPLOSIVES ON AIRLINE PASSENGERS
Eugene K. Achter, Gabor Miskolczy, Freeman W. Fraim, Eugenie Hainsworth (Little, Arthur D., Inc., Cambridge, MA.), and John R. Hobbs (Department of Transportation, Cambridge, MA.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 427-434 (For primary document see N93-21856 07-03)
(Contract DTRS-57-84-C)
Avail: CASI HC A02/MF A10

Terrorist bombs have been planted in passenger compartments as well as luggage compartments of airliners. To guard against terrorist bombing attacks by this route, passengers as well as luggage should be screened for explosives. Under contract to the U.S. Department of Transportation, Thermedics developed SecurScan, a prototype portal system for screening airline passengers for explosives, and carried out limited airport testing. SecurScan is an integrated system consisting of a personnel sampling portal, a preconcentrator for explosives vapor, particulate, and aerosol, and a fast GC/chemiluminescence module for sensitive and selective detection and analysis of explosives. Design considerations for efficient sampling of explosives from human subjects in an airport environment is discussed. For the sampling portal, the essential functional criteria include sampling effectiveness, acceptable human factors, and passenger throughput. General design considerations and their specific implementation in the SecurScan portal system are discussed. Derived from text

N93-21897# Naval Research Lab., Washington, DC. Chemistry Div.
EXPLOSIVES DETECTION BY PURE N-14 NQR
Allen N. Garroway, J. B. Miller, and M. L. Buess (Sachs/Freeman Associates, Inc., Landover, MD.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 435-440 Sponsored by FAA and the Indian Head Naval Ordnance Station (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

The goal of this project is to execute a proof-of-concept nuclear quadrupolar resonance (NQR) detection of explosives and, further, to explore NQR techniques in the laboratory in sufficient detail so that we can provide realistic design criteria for an NQR prototype fieldable at an airport. Experimental guidelines are the detection of sub-kilogram quantities of explosives within 6 seconds with a detection probability of 99 percent and false alarm rate no greater than 1 percent for RDX. We concentrate on RDX-based explosives since, on the basis of published data, RDX is (one of) the most favorable explosives to detect by NQR. Our primary focus is a detector for checked baggage, but we also consider NQR for potential application to examining people. For a suitcase size detector, the goal is detection of sub-kilogram quantities of explosives, and a lower detectable quantity for people scanning. Author

N93-21898# Spatial Dynamics Applications, Inc., Acton, MA.
EXPLOSIVE DETECTION USING DIELECTROMETRY
Dewitt Clint Seward and T. Yukl (Spatial Dynamics, Acton, MA.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 441-453 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

The dielectrometer detects using dielectric constant and loss tangent. The basis for the technology and for the existing instruments is the patented antenna/lens combination. The instrument establishes a standing wave of microwave energy in a fixed field configuration. It allows a wide range of non-contacting internal measurements. This technology forms the basis of existing instruments widely deployed. Dielectric technology can detect changes in chemicals and materials with a high degree of reliability. In many cases, such as finding cocaine dissolved in sealed bottles of wine and liquor, the detection of items and substances has proven to be a definitive GO/NO-GO tester. Dielectric technology can also identify detected

items on a limited basis at present, with the promise of improved identifications as the technology develops. Derived from text

N93-21899# Quantum Magnetics, Inc., San Diego, CA.
LIQUID EXPLOSIVES SCREENING SYSTEM
Dale R. McKay, Charles R. Moeller, Erik E. Magnuson, and Lowell J. Burnett *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 454-464 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

Nuclear Magnetic Resonance (NMR) techniques have been developed to verify the liquid contents of beverage containers commonly carried aboard aircraft, thereby detecting substitution of explosive liquids for the normal contents. The capability of NMR to distinguish between liquids is well known, but conventional NMR equipment is bulky and expensive. NMR systems generally require the application of an extremely strong and homogeneous magnetic field over the volume of the sample. The magnet used to generate this field largely determines the size and cost of the NMR system, particularly when large samples such as beverage bottles must be accommodated. A detection strategy requiring modest magnetic field strength and homogeneity was developed for distinguishing explosive liquids from alcoholic beverages. A small magnet capable of applying such a field to common beverage containers was designed and a prototype was built and tested. Derived from text

N93-21900# San Diego State Univ., CA. Dept. of Physics.
IMPROVED NMR SIGNATURES OF EXPLOSIVES
Lowell J. Burnett and John P. Sanders *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 465-477 Sponsored by FAA and Edgerton, Germeshausen and Grier, Inc. (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

A program to identify unique proton nuclear magnetic resonance (NMR) signatures for explosive compounds is described. In many explosives a significant fraction of the hydrogen nuclei (protons) are coupled to nitrogen nuclei. The energy level diagrams of these proton/nitrogen pairs contain both allowed and weakly allowed transitions. In the measurements reported, weakly allowed transitions in the sample were irradiated with RF energy and the resulting effects on the proton NMR signal were recorded. Author (revised)

N93-21901# Southwest Research Inst., San Antonio, TX.
APPLICATION OF MAGNETIC RESONANCE TO EXPLOSIVES DETECTION
James Derwin King, Armando DeLosSantos, Colin I. Nicholls, and Williams L. Rollwitz *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 478-485 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

An essential element in airport security is the inspection of all hand carried items and checked baggage to detect concealed explosives as well as weapons. An acceptable explosives detection system must be effective in the detection of all explosives that pose a threat to the safety of the passengers, crew, and aircraft. It must rapidly and reliably distinguish between explosives and non-explosives and provide detection independent of explosive configuration and distribution. To avoid unnecessary delays the system must also provide rapid automated inspection and have as low a nuisance alarm rate as is consistent with operational and security effectiveness. In addition, the apparatus should not pose a health hazard to either the public or the operators nor damage baggage or contents. It should be reliable and friendly and should be economically affordable in initial cost, installation, and operation. Development of the technology or combination of technologies needed to achieve these goals has posed a tremendous challenge to the scientific research and engineering communities. Radio Frequency Resonant Absorption Spectroscopy (RRAS) techniques were considered early in the efforts to find an acceptable solution to this inspection problem and these methods still provide features and capabilities that are largely unmatched by other technologies. Much of the work to successfully apply one of these techniques, hydrogen transient nuclear magnetic resonance (HTNMR), to the practical detection of explosives concealed in letters, parcels, and baggage was performed. Author (revised)

N93-21902# SRI International Corp., Menlo Park, CA. Remote Measurements Lab.
EXPLOSIVE DETECTION USING MICROWAVE IMAGING
David G. Falconer and David Gray Watters *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 486-492 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

We have developed a microwave technique for detecting high-explosives (HEs), illegal drugs, and other contraband in checked airline luggage. Our technique detects chemical contraband by microwave radiation and measuring the magnitude and phase of the backscattered radiation with coherent receivers. From the collected data, we form a three-dimensional image of the checked luggage and its contents by means of pulse-synthesis and synthetic-aperture techniques. Special image-segmentation software isolates suspicious portions of the microwave image in preparation for spectroscopic analysis. We estimate the microwave spectrum of the isolated volumes using an inverse Fourier-transform algorithm. Suspicious chemicals are identified by examining the estimated spectrum for characteristic absorption lines and resonance structure. We have demonstrated our inspection technique using simulants for both HE and cocaine. In particular, we have used our microwave anechoic chamber to illuminate and image a soft-sided suitcase containing both powdered sugar (our cocaine simulant) and ammonium sulfate (our HE simulant). We then segmented the suspicious portion of the microwave image. Using inverse algorithms, we returned our segmented data to the frequency domain and thereby obtained rough estimates of the microwave spectra of the suspicious regions. Finally, we have compared the estimated spectra with reference ones taken on bulk samples of the same materials and were readily able to differentiate the two simulants. Derived from text

N93-21903# Army Electronics Technology and Devices Lab., Fort Monmouth, NJ.
CONSIDERATION OF UNTRIED MAGNETIC RESONANCE TECHNIQUES FOR POSSIBLE BAGGAGE ANALYSIS
Edward H. Poindexter, H. A. Leupold, Richard Harold Wittstruck, and G. J. Gerardi (William Patterson Coll. of New Jersey, Wayne.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 493-504 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

Magnetic resonance has been under consideration for nearly 20 years as a possible means to detect explosives in airline baggage, as described in several other papers in this present proceedings. In particular, nuclear magnetic resonance (NMR) has been subject to substantial test and evaluation via operational prototype apparatus. NMR is usefully limited to reliance on one resonant signal, viz., that of the hydrogen nucleus. This is the only nucleus present in adequate concentration in explosives for sufficient signal-to-noise ratio. The NMR method is practically limited by several considerations to use of magnetic fields below 1000 Oe. This rules out any application of frequency- or field-dependent spectroscopic signatures, on which so much chemical research and analysis is based. Rather, discrimination is based on a rather unique combination of relaxation phenomena in explosives -- viz., long T(sub 1) and short T(sub 2), which is in contrast to all expected substances likely to be found in baggage (including the luggage container). A further boon is the quadruple resonance (NQR) of nitrogen nuclei, which is field-independent. By tuning the NMR to the NQR frequency (requiring a field of about 800 Oe), a very efficient level-crossing energy transfer occurs, and both the sensitivity and uniqueness of the signature are greatly enhanced. Nonetheless, certain weaknesses and ambiguities of low-field NMR make it desirable to seek enhancements or operational alternatives. This paper presents limited results and discussion of some possible enhancements. Derived from text

N93-21904# Thermedics, Inc., Woburn, MA.
DICHOTOMOUS KEY APPROACH FOR HIGH CONFIDENCE LEVEL IDENTIFICATION OF SELECTED EXPLOSIVE VAPORS
David H. Fine, David P. Rounbehler, and William A. Curby *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 505-509 (For primary document see N93-21856 07-03)
Avail: CASI HC A01/MF A10

Explosive vapor detectors are chemical sensors which have been tuned

to detect a few critical chemical compounds at very low concentrations, even when the explosive molecules are immersed in a sea of background material. Their performance and effectiveness are limited to how well they can be tuned to reject extraneous compounds and signals. While sensitivity is also important, selectivity is by far the dominant factor. For this reason, this paper focusses on detectability, which is an instrument's ability to discriminate between the analyte of interest and the background signal consisting not only of the summation of electronic and chemical noise, but also responses due to unknown chemical compounds in the sample matrix. Derived from text

N93-21905# Sandia National Labs., Albuquerque, NM.
EXPLOSIVE VAPOR EMISSION **c28**
Bernard T. Kenna, Frank J. Conrad, and David W. Hannum *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 510-517 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

Emission rates of explosive vapors from explosive samples dictate whether a technique will provide a constant explosive vapor source for instrument evaluation. Indeed, emission rates determine whether a particular detection system is applicable directly for explosive vapor detection of it an initial 'helping' step, such as preconcentration, is required. Two questions facing explosives vapor detection are: (1) Is there sufficient explosive vapor from an explosive device to permit detection? and (2) Can an explosive vapor source be constructed which will provide a constant, known amount of explosive vapor to test explosive vapor detection systems? Many papers have been written regarding the first question. The most complete work on vapor pressure has been reported by Dionne, Rounbehler, Achter, Hobbs, and Fine and addresses the equilibrium vapor pressure as a function of temperature for various explosives, including TNT and RDX. T. A. Griffy has developed a model to predict expected explosive vapor concentration for various scenarios. Derived from text

N93-21906# Ion Track Instruments, Inc., Wilmington, MA.
A THERMODYNAMIC STUDY OF THE VAPOR PRESSURES OF C-4 AND PURE RDX **c28**
William McGann, Anthony Jenkins, and K. Ribeiro *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 518-531 (For primary document see N93-21856 07-03)
(Contract DTFA03-87-C-00005)
Avail: CASI HC A03/MF A10

One of the central requirements in the design of a chemical detection system is the understanding of the physical and chemical properties of the targeted compounds. In vapor detection systems for explosive compounds, the factor which ultimately limits the sensitivity is the amount of vapor available to the detector. Although this factor is a function of many variables including the efficiencies for vapor collection, transport, trapping and detection, it depends largely on the equilibrium vapor pressures of the compounds considered to pose a significant threat, RDX-based explosives exhibit the lowest vapor pressures. The vapor pressure of RDX has been reported to be 4.6 x 10(exp -9) mmHg (Dione, Edwards, Rosen). This corresponds to a saturated vapor concentration of 6 ppt at room temperature. It is often the case that researchers gauge the sensitivity of their instruments in the laboratory with pure RDX in its native crystalline form. From the point of view of setting 'benchmark standards' in the laboratory, this approach is highly recommended. However, it does not give a good indication of the systems ability to measure vapor from C-4 which is a solid solution of several organic compounds. In this work, we report on the differences in the vapor pressure between pure RDX and C-4. The arguments presented are based on a series of experiments in the laboratory in which the signal response versus temperature of C-4 was measured and compared to pure RDX. Using the known literature values for the pure compound and a thermodynamic model based on the Clausius-Clapeyron equation, the vapor pressure of military grade C-4 has been determined. From these data, an estimate of the maximum amount of vapor available from C-4 can be made. Derived from text

N93-21907# Ion Track Instruments, Inc., Wilmington, MA.
EXTRACTION, TRANSPORTATION AND PROCESSING OF EXPLOSIVES VAPOR IN DETECTION SYSTEMS **c28**
Anthony Jenkins, William McGann, and K. Ribeiro *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 532-551 (For primary document see N93-21856 07-03)
(Contract DTFA03-87-C-00005)
Avail: CASI HC A03/MF A10

The perceived need for non-intrusive, hands off, detection systems for the detection of explosives on people and in baggage has heavily influenced the design of such systems. Ion Track Instruments has for many years designed and produced walk-through portal vapor detectors and hand held sniffers which sample the air around people and bags in order to detect the presence of explosives. Existing systems for portal detection of explosives such as the ITI 85 Entry Scan employ air curtain samplers which impinge on the body and sweep any entrained vapors into the trap of the detection system. Sampling flow rates in air curtains of portals have been variously employed by ITI and others at 25 l/s, 100 l/s and 250 l/s. In a typical test of six seconds duration, air volumes of between 150 and 1,500 liters have to be processed for one check. The detector used in such systems has typically less than 1 ml of internal volume. This means that for each test the volume containing the explosive molecules must be reduced by factors in the range from 10(exp 4) to 10(exp 6). We have shown that this is impossible to achieve without losing most of the explosive molecules which may have been sampled. Several studies and experiments have been conducted to examine the feasibility and efficiency of low flow intimate sampling systems. The principle can be applied to both portal and baggage detection systems and design solutions for both scenarios have been proposed and tested. Derived from text

N93-21908# Thermedics, Inc., Woburn, MA.
VAPOR SAMPLING USING CONTROLLED HEATING **c28**
Edward E. A. Bromberg, A. Lindsay Carroll, Freeman W. Fraim, and David P. Lieb *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 552-558 Sponsored by State Dept. (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

In the typical use of a vapor explosive detection system, explosive devices hidden by a terrorist in a package, suitcase on a person etc., are being searched for. While the practical sensitivity required to alarm on 99(+) percent of the potential devices is not known, it is recognized that the more sensitive the system is the higher is the probability of detection. For most vapor explosive detection systems there are at least two major sections, the sampling section and the analysis section. The analysis section itself can often further be broken down into major sub-components. In order to increase the total sensitivity, one could increase the sensitivity of one or all of the components. In this paper we will focus on increasing the sensitivity of the sampling device. The important issue of increasing the sensitivity of the analysis device, or the equally important issue of selectivity, will not be addressed. Derived from text

N93-21909# Thermedics, Inc., Woburn, MA.
EFFICIENT COLLECTION OF EXPLOSIVE VAPORS, PARTICLES AND AEROSOLS **c28**
Freeman W. Fraim, Eugene K. Achter, A. Lindsay Carroll, and Eugenie Hainsworth (Little, Arthur D., Inc., Cambridge, MA.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 559-570 Sponsored in cooperation with the State Dept. (For primary document see N93-21856 07-03)
(Contract DTRS-57-84-C)
Avail: CASI HC A03/MF A10

Many explosive detection applications require the collection of explosive vapors, or fine particulates from air samples. In applications such as detecting explosives from airline passengers or their luggage, the air volume that has to be sampled is quite large because of the size of the item samples, or in the case of passengers because it is not possible to confine them in a small sampling space. In these applications, the task is to extract the explosives present from a large air sample. This can be done either by sampling a portion of the total air sample, hoping that the whole sample is well mixed so that the explosives are present in the extracted sample, or by sampling the entire air volume. The disadvantage of the former approach is obviously that the quantity of explosives in the portion samples is reduced by the fraction of the whole sample that is taken, assuming that the entire sample is well mixed. The disadvantage of the second approach is that it becomes difficult to efficiently sample a large air volume in a practical time frame, typically five to ten seconds. ThermedeTec's approach for

sampling a large volume has been to sample as much of the total sample as possible. The reduction in effective sensitivity if only a small portion is sampled is felt to be too large a sacrifice in sensitivity, resulting in an impractically high limit of detection. Thus the main design task has been to develop a collection means that can handle large air volumes at high flow rates and achieve good collection efficiency. Derived from text

N93-21910*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
NEGATIVE-ION FORMATION IN THE EXPLOSIVES RDX, PETN, AND TNT USING THE REVERSAL ELECTRON ATTACHMENT DETECTION (READ) TECHNIQUE
Ara Chutijian, S. Boumsellek, and S. H. Alajajian *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 571-583 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

In the search for high sensitivity and direct atmospheric sampling of trace species, techniques have been developed such as atmospheric-sampling, glow-discharge ionization (ASGDI), corona discharge, atmospheric pressure ionization (API), electron-capture detection (ECD), and negative-ion chemical ionization (NICI) that are capable of detecting parts-per-billion to parts-per-trillion concentrations of trace species. These techniques are based on positive- or negative-ion formation via charge-transfer to the target, or electron capture under multiple-collision conditions in a Maxwellian distribution of electron energies at the source temperature. One drawback of the high-pressure, corona- or glow-discharge devices is that they are susceptible to interferences either through indistinguishable product masses, or through undesired ion-molecule reactions. The ASGDI technique is relatively immune from such interferences, since at target concentrations of less than 1 ppm the majority of negative ions arises via electron capture rather than through ion-molecule chemistry. A drawback of the conventional ECD, and possibly of the ASGDI, is that they exhibit vanishingly small densities of electrons with energies in the range 0-10 millielectron volts (meV), as can be seen from a typical Maxwellian electron energy distribution function at T = 300 K. Slowing the electrons to these subthermal (less than 10 meV) energies is crucial, since the cross section for attachment of several large classes of molecules is known to increase to values larger than 10(exp -12) sq cm at near-zero electron energies. In the limit of zero energy these cross sections are predicted to diverge as epsilon(exp -1/2), where epsilon is the electron energy. In order to provide a better 'match' between the electron energy distribution function and attachment cross section, a new concept of attachment in an electrostatic mirror was developed. In this scheme, electrons are brought to a momentary halt by reversing their direction with electrostatic fields. At this turning point the electrons have zero or near-zero energy. A beam of target molecules is introduced, and the resultant negative ions extracted. This basic idea has been recently improved to allow for better reversal geometry, higher electron currents, lower backgrounds, and increased negative-ion extraction efficiency. We present herein application of the so-called reversal electron attachment detector (READ) to the study of negative-ion formation in the explosives molecules RDX, PETN, and TNT under single-collision conditions. Derived from text

N93-21911# Thermedics, Inc., Woburn, MA.
CALIBRATION METHODS FOR EXPLOSIVES DETECTORS **c35**
Stephen J. MacDonald and David P. Rounbehler *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 584-588 (For primary document see N93-21856 07-03)
Avail: CASI HC A01/MF A10

Airport security has become an important concern to cultures in every corner of the world. Presently, efforts to improve airport security have brought additional technological solutions, in the form of advanced instrumentation for the detection of explosives, into use at airport terminals in many countries. This new generation of explosives detectors is often used to augment existing security measures and provide a more encompassing screening capability for airline passengers. This paper describes two calibration procedures used for the Thermedics' EGIS explosives detectors. The systems were designed to screen people, electronic components, luggage, automobiles, and other objects for the presence of concealed explosives. The detectors have the ability to detect a wide range of explosives in both the vapor state or as surface adsorbed solids, therefore, calibrations were designed to challenge the system with explosives in each form. Derived from text

N93-21912# Amerasia Technology, Inc., Westlake Village, CA.
VAPOR DETECTION USING SAW SENSORS **c35**
Gary Wayne Watson, W. Horton, and Edward Jerome Staples, Jr. *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 589-603 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

Reported here are SAW sensors for detecting explosive material vapors at picogram (1 x 10(exp -12)) and even femtogram (1 x 10(exp -15)) concentrations. These SAW sorption sensors utilize a physical area no larger than the smallest quartz capillary column. In effect, the sensor is on the head of a pin. Using a SAW resonator structure operating at 500 MHz, a nearly 4 order increase (10,000) in scale factor is achieved. Derived from text

N93-21913# Fisk Univ., Nashville, TN. Dept. of Physics.
FOURIER-TRANSFORM INFRARED SPECTROSCOPY APPLIED TO EXPLOSIVE VAPOR DETECTION **c25**
Don O. Henderson, Enrique Silberman, and F. W. Snyder (Federal Aviation Administration, Atlantic City, NJ.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 604-617 (For primary document see N93-21856 07-03)
(Contract DTFA01-87-C-00042)
Avail: CASI HC A03/MF A10

The infrared part of the electromagnetic spectrum extends from 10,000 to 5 cm(exp -1). This broad spectral range is further classified into the near-IR, mid-IR, and the far-IR. It is the interaction of this radiation with matter which is responsible for exciting vibrational transitions. In the near-IR, harmonics and combination transitions are typically observed, while in the far-IR, phonons in crystals, and rotational transitions in the gas phase are commonly observed. In the mid-IR, transitions associated with fundamental molecular vibrations may be measured and is often referred to as the fingerprint region. It is this part of the spectrum which is of interest with regard to explosive materials. In particular, since many explosives have the -NO2 group in common, absorptions due to this group serve as signature in the infrared spectra of explosives. Consequently, we present here, in some detail the infrared spectra of explosives measured using selected sampling techniques, and in some cases describe the interaction of explosives with metal oxide substrates in which they are adsorbed. Derived from text

N93-21914# Brigham Young Univ., Provo, UT. Dept. of Chemistry.
ATMOSPHERIC PRESSURE IONIZATION TIME-OF-FLIGHT MASS SPECTROMETER FOR REAL-TIME EXPLOSIVES VAPOR DETECTION **c35**
Harold G. Lee, Edgar D. Lee, and Milton L. Lee *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 619-633 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

In this study we report a high-sensitivity, easy-to-use chemical analyzer for the detection of trace volatile explosive chemicals in ambient air, based on a time-of-flight mass spectrometer (TOFMS) with an API source. Because of its unique design, it is much more sensitive than other mass spectrometers; subfemtogram (less than 10(exp -15) g) detection limits are possible. As with other mass spectrometers, the TOFMS separates ions according to their mass-to-charge ratio and thus gives the best selectivity among all other non-MS based detectors. The ultrahigh sensitivity obtained in TOFMS precludes the use of a preconcentration stage. The mass resolution is approximately 500. Simultaneous analyses for up to 16 compounds can be accomplished within 200 microseconds. Derived from text

N93-21915# Scientech, Inc., Idaho Falls, ID.
REAL-TIME EXPLOSIVES/NARCOTICS VAPOR ENHANCEMENT AND COLLECTION SYSTEMS FOR USE WITH THE ATMOSPHERIC PRESSURE IONIZATION TIME-OF-FLIGHT MASS SPECTROMETER **c35**
M. Marx Hintze, Byron L. Hansen, and Russell L. Heath *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 634-636 (For primary document see N93-21856 07-03)
Avail: CASI HC A01/MF A10

This paper is a companion document to the Atmospheric Pressure

Ionization Time-of-Flight Mass Spectrometer (API TOFMS) presentation (Lee, et al., 1992). Two significant technique challenges related to design and implementation of vapor collection systems are addressed. They are as follows: (1) freeing deposited or trapped explosive material particles or vapor; and (2) transportation of sample specimen from the pickup point to the detector. Addressed in this dissertation will be both hand-held collection and air shower booth accumulation. Derived from text

N93-21916# Oak Ridge National Lab., TN. Analytical Chemistry Div.
DETECTION OF EXPLOSIVES MATERIAL ON SINGLE MICROPARTICLES **c28**
W. B. Whitten, John Michael Dale, and J. M. Ramsey *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 637-641 Previously announced as N92-17962 (For primary document see N93-21856 07-03)
(Contract DE-AC05-84OR-21400)
Avail: CASI HC A01/MF A10

Some of the explosive materials with very low vapor pressure such as RDX or PETN are most likely to be encountered either as solids or adsorbed on solids. We are developing a new technique for the chemical characterization of explosive bearing microparticles based upon the use of electrodynamic traps. Single microparticles are analyzed by laser ablation mass spectrometry in an ion trap detector. Derived from text

N93-21917# Oak Ridge National Lab., TN. Analytical Chemistry Div.
TANDEM MASS SPECTROMETRY FOR EXPLOSIVES VAPOR DETECTION **c25**
Gary L. Glish, S. A. McLuckey, B. C. Grant, and H. S. McKown *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 642-652 (For primary document see N93-21856 07-03)
(Contract DE-AC05-84OR-21400)
Avail: CASI HC A03/MF A10

Atmospheric sampling glow discharge ionization (ASGDI) has been shown to be a highly sensitive ion source for the detection of explosive compounds in air. We first interfaced this ion source with a home-built quadrupole/time-of-flight (QT) instrument. A second MS/MS instrument, a Finnigan ion trap mass spectrometer (ITMS), was then modified extensively to adapt the ASGDI source. We have recently interfaced an ASGDI source with a Finnigan TSQ 700 tandem quadrupole instrument. Part of the rationale behind this work was to adapt ASGDI in a very simple and inexpensive manner to a widely availalbe state-of-the-art tandem mass spectrometer. The purposes of this paper are to describe the modification to the TSQ 700 and to show illustrative data obtained with the ASGDI/TSQ 700 combination. To provide a context for the TSQ 700 results we also present data acquired with equal analyte levels with the two other tandem mass spectrometers. Derived from text

N93-21918# SCIEX, Thornhill (Ontario).
MODIFICATIONS TO THE IONIZATION PROCESS TO ENHANCE THE DETECTION OF EXPLOSIVES BY API/MS/MS **c25**
William R. Davidson, Bruce A. Thomson, Takeo Sakuma, William R. Stott, Alan Keith Akery (British Aerospace Security Systems, Bristol, England.), and Richard Sleeman (British Aerospace Security Systems, Bristol, England.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 653-662 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

In systems which are dependent upon the formation of ions through chemical processes, great gains in both sensitivity and selectivity can be achieved through modifications to the reagent ions. In particular, for nitroesters and cyclic nitramines, adding the chloride ion as a reagent can increase the detection capability of an ion-based analytical system, such as the CONDOR MS/MS, by over an order of magnitude. As demonstrated by the results presented in this paper, the higher probability of detection is a combination of higher sensitivity for the formation of mass-related parent ions, lower chemical background and highly specific fragmentation patterns for the resulting chloride addition reaction products. Derived from text

N93-21919# SCIEX, Thornhill (Ontario).
THE ROLE OF MASS SPECTROMETRY IN THE DETECTION OF EXPLOSIVES **c25**
William R. Davidson, William R. Stott, Alan Keith Akery (British Aerospace Security Systems, Bristol, England.), and Richard Sleeman (British Aerospace Security Systems, Bristol, England.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 663-671 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

The CONDOR system is based on the rapid analysis of complex samples (for example, air cargo vapors and residual dust particles) for the presence of trace levels of contraband material using atmospheric pressure chemical ionization (APCI) coupled with tandem mass spectrometry (MS/MS). The two key areas which separate it from other methods of contraband detection are the sample acquisition network and the method of analysis.
Derived from text

N93-21920# Barringer Research Ltd., Rexdale (Ontario).
MODIFICATION TO THE IONIZATION PROCESS TO ENHANCE THE DETECTION OF EXPLOSIVES BY IMS **c25**
Lucy L. Danylewych-May *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 672-686 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

The ionization of trace compounds at atmospheric pressure in plasma chromatography is accomplished by ion-molecule reactions. The nature of the ions formed depends on the type of reactant ions generated by the ionization source in the reaction region and the operating temperature in the ionization and drift tube regions. Using Ni-63 as an ionization source and air as drift and carrier gas the free electrons are converted to primarily (H2O)m.O2(-) ions. The ion chemistry in the IONSCAN can easily be modified by changing reactant ion through introduction of a suitable dopant to facilitate formation of molecular ions and molecule-ion clusters from trace compounds. The types of ions formed from several explosive substances and taggants of interest are discussed. Derived from text

N93-21921# Texas A&M Univ., Galveston.
FOURIER TRANSFORM ION-CYCLOTRON RESONANCE (FT-ICR) MASS SPECTROMETRY OF RDX, PETN AND OTHER EXPLOSIVES **c28**
C. S. Giam, M. S. Ahmed, R. R. Weller, and Jennelle Derrickson *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 687-688 (For primary document see N93-21856 07-03)
Avail: CASI HC A01/MF A10

Previous investigations of explosives by conventional mass spectrometry using electron impact (EI) ionization have shown that the explosives underwent extensive fragmentation and did not provide molecular weight information. We wish to present the Fourier Transform Ion-Cyclotron Resonance-Mass Spectrometry (FT-ICR-MS) investigations of RDX, PETN, and TNT. The theory, instrumentation and methodology of FTMS have been described in detail elsewhere. All experiments are carried out using an Extrel FTMS-1000 equipped with a Tachisto 215G pulsed CO2 laser and a 5.08 cm cubical cell. EI and self-chemical ionization (SCI) spectra are obtained at 50 eV electron energy; electron capture (EC) spectra at 02. eV. A delay of 3 ms, 500 ms and 200 ms was allowed between ion excitation and detection in EI, SCI and EC respectively. In laser desorption ionization (LDI) a delay of 5 seconds was introduced to allow most of the neutrals to be pumped away. The laser pulsed at 10.6 micron m with repetition rate of 2 per second delivering approximately 10(exp 8) Watts/cu cm in 45 ns. Other details may be found in our earlier publication.
Derived from text

N93-21922# Federal Bureau of Investigation Academy, Quantico, VA. Forensic Science Research Unit.
DETECTION OF TRACE EXPLOSIVE EVIDENCE BY ION MOBILTY SPECTROMETRY **c25**
Dean D. Fetterolf and Tracy D. Clark (Southwest Missouri State Univ., Springfield.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 689-702 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

As part of an ongoing research effort, the FBI Laboratory has been evaluating new technology and the innovative adaptation of existing technology for use in counterterrorism and counternarcotics investigations. Ion mobility spectrometry (IMS), first introduced in 1970 is currently

experiencing a resurgence of interest as a specific purpose detection system. Because of the exceedingly low vapor pressure of explosives (ppm to ppt), the detection of plastic explosives by vapor methods alone has been difficult. We have been examining the application of an Ionscan Model 200 by Barringer Instruments, Inc., in detection of modern explosives in a variety of scenarios of forensic interest by collecting particulate matter. The IMS has many of the advantages of conventional laboratory instruments such as good sensitivity, selectivity, speed, size, and ease of use. This ease of use and portability permit operation in real world situations.

Derived from text

N93-21923# Thermedics, Inc., Woburn, MA.

ANALYSIS OF EXPLOSIVES USING HIGH SPEED GAS CHROMATOGRAPHY WITH CHEMILUMINESCENT DETECTION **c25**

David P. Rounbehler, Stephen J. MacDonald, David P. Lieb, and David H. Fine *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 703-713 Sponsored in cooperation with the State Dept. (For primary document see N93-21856 07-03)

(Contract DTRS-57-84-C)

Avail: CASI HC A03/MF A10

Chemiluminescent detection has been demonstrated to be both sensitive and specific for the detection of explosives. The previous speed of GC analysis has been increased by over 2 orders of magnitude such that it is now practical for use for the detection of explosives in airport settings. The end result of the two column HSGC and pyrolysis is that there are no C-nitro compounds detected in that part of the chromatogram containing the nitrite esters or the nitramines. The main benefit of the 2 column separation technique is that, C-nitro compounds cannot interfere with the detection of plastic explosives. This has made a highly specific detection system even more specific. This increase in selectivity is important since there are several widely used C-nitro compounds found in perfumes, paints, dyes and other products. These compounds can also be found as pollutants in ambient air and, perhaps, on objects such as luggage.

Derived from text

N93-21924# Scintrex Ltd., Concord (Ontario).

A GC/ECD APPROACH FOR THE DETECTION OF EXPLOSIVES AND TAGGANTS **c28**

Sabatino Nacson, Bob Mitchner, Otto Legrady, Tony Siu, and S. Nargolwalla *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 714-721 (For primary document see N93-21856 07-03)

Avail: CASI HC A02/MF A10

Since its introduction to the market some 6 years ago, the explosives vapor detector (EVD)-1 has achieved an enviable reputation as an explosive detector due mainly to its sensitivity, specificity and durability. This paper is intended to report on the expanded capabilities of the EVD-1 for the detection of all proposed ICAO taggants in addition to the conventional type of explosives (nitroglycerin, dinitrotoluene (DNT)). Most interesting is its ability to detect PETN from plastic explosives. Derived from text

N93-21925# Bundeskriminalamt, Wiesbaden (Germany).

MARKING OF GERMAN PLASTIC EXPLOSIVE FOR THE ENHANCEMENT OF VAPOR DETECTION **c28**

Peter Kolla *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 723-733 (For primary document see N93-21856 07-03)

Avail: CASI HC A03/MF A10

The detectability of German plastic explosive is considerably enhanced with addition of the tagging substances. The best results were obtained by marking with o-mononitrotoluene but the evaluation of stability investigations shows that both nitrotoluenes are lost very fast by storing the unwrapped explosives. Additionally, the carcinogenic properties of the nitroaromatic taggants may prevent their usage. Dimethyldinitrobutane shows a moderate detection behavior, but it seems to stick for a longer time in the plastic explosive. Some serious doubts exist about the routine checks of real baggage. Because the existing vapor detectors have to be extended with additional detection windows for all the possible taggants, the false alarm rate may increase to a very high value. Especially for the nitrotoluenes which have very similar polarities and vapor pressures to a lot of odorous substances. Some experiences in recent explosives vapor detector (EVD) tests in Germany showed possible interferences between nitroaromatics and perfumes. If false alarm rate only rises in the range higher than 1 percent, the usage of the method may be impractical. Author

N93-21926# Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ.

PROGRAM TO TAG MILITARY PLASTIC/SHEET EXPLOSIVES **c28**

Yukwei Sarah Eng, Joseph A. Lannon, and Carolyn Westerdahl *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 734-736 (For primary document see N93-21856 07-03)

Avail: CASI HC A01/MF A10

The first objective of this program was to identify candidate taggants that: are reliably detectable by commercial vapor detectors with minimal false alarms; compatible with the explosives with which they come in contact; do not degrade other materials with which they are packaged; do not degrade the performance or safety of the plastic explosive in which they are incorporated; have an acceptable lifetime within the explosive; and can be safely manufactured and stored. After identifying the most promising taggant, this program has the following goals: to carry out all necessary health and safety tests; to ensure that the explosive and the related items can be produced; identifying all items within the DoD which use plastic explosives; to test and requalify them as necessary; and to manage the inventory so the minimum amount needs to be disposed of in 1997. Author

N93-21927# Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ.

AN IMPROVED VAPOR TAGGANT DETECTOR **c28**

Tung-Ho Chen *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 737-738 (For primary document see N93-21856 07-03)

Avail: CASI HC A01/MF A10

An international effort in the tagging of plastic explosives with vapor taggants culminated in the signing of an international convention this year. As part of this effort, we conducted the detectability of a vapor taggant in concealed modified Composition C-4 using several off-the-shelf portable commercial explosive vapor detectors. One detector was found to perform well. However, this detector which is based on a gas chromatograph/electron capture detector (GC/ECD) has a turnaround time of approximately two minutes. This is, of course, too long for passenger screening purposes. Furthermore, the retention windows are fairly wide which could lead to potential false alarms. In addition, the hand-held sampler does not lend itself for automated sampling applications. The ion mobility spectrometer (IMS) type detectors were found to be unsatisfactory for the detection of the taggant. The objective of this paper is to briefly spell out the general requirements for optimizing various important parameters such as the turnaround time, sensitivity and selectivity of detection, and the sampling protocol. Derived from text

N93-21928# Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ.

PLANT LABORATORY SCALE PREPARATION AND COMPLETE CHARACTERIZATION OF MODIFIED COMPOSITION C-4 CONTAINING A TAGGANT **c28**

Tung-Ho Chen, C. Campbell, R. Reed, W. F. Ark, J. Autera, D. A. Wiegand, and M. S. Kirshenbaum *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 739-740 (For primary document see N93-21856 07-03)

Avail: CASI HC A01/MF A10

An international effort in the tagging of plastic explosives with vapor taggants culminated in the signing of an international convention this year. As part of this effort, modified Composition C-4 homogeneously tagged with 1 and 0.1 wt percent vapor taggant were prepared at plant laboratory scale and a complete characterization of the modified Composition C-4 was conducted. The objective of this paper is to evaluate all parameters which are crucial in the detection of concealed tagged plastic explosives, performance of tagged explosives, and safety. Preparation of homogeneous specimens is critical to obtaining valid conclusions. The parameters investigated include homogeneity, detectability, life-time, stability, compatibility, performance, sensitivity, mechanical properties, and toxicity.

This paper will briefly describe the comprehensive studies conducted and discuss the conclusions obtained. Derived from text

N93-21929# Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ.
DETECTION OF TAGGANT IN MODIFIED COMPOSITION C-4 TAGGED WITH A TAGGANT **c28**
Tung-Ho Chen, C. Campbell, and R. A. Reed *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 741-751 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

In the comparative evaluation of the detectability of vapor taggants from concealed plastic explosives, it is absolutely essential to develop a standard detection protocol which is capable of obtaining reproducible results. The current protocol is grossly inadequate for yielding such data. Thus, the recent comparative studies by international experts on the comparative evaluations of the detectability of vapor taggants from concealed plastic explosives have been unsatisfactory. The aim of this paper is to examine various parameters of the detection protocol and devise a scheme including design and sampling procedure changes to obtain reproducible detector response. The improvement strategy essentially involves redesign of the sampling slit and sampling procedure which ensure sampling of vapors from inside the suitcase. Derived from text

N93-21930# Diametrix Corp., San Diego, CA.
DRY IMMUNOCHEMICAL SENSOR FOR THE DETECTION OF PETN VAPOR **c35**
Herbert Richard Lukens *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 753-758 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

Giaever (1973) showed that an indium semi-mirror coated with a monolayer of a substance would undergo reduced optical reflectance after incubation with a solution of the substance's antibody. He was able to see the effect with the naked eye. Lukens and Williams (1977) reversed the process by first attaching the target substance's antibody to the semi-mirror, after which the device would show a decline in optical density when exposed to a solution of the target substance. Lukens and Williams (1982) subsequently found that the device could also be used as an immunochemical film badge (IFB) to detect an airborne target substance. Early efforts to develop the IFB for the detection of airborne substances were plagued by such a high degree of performance variability that there were doubts in some quarters that an airborne target substance could bind to its antibody until Lukens (1990) demonstrated such binding in experiments with radiolabeled cocaine and morphine. Recently improved semi-mirrors and densitometry have been obtained and have led to improved performance of IFB's. As shown in this paper, IFB's can now be constructed that detect PETN vapor in a few seconds. Derived from text

N93-21931# State Univ. of Western Connecticut, Danbury.
THE CHALLENGE OF BIODETECTION FOR SCREENING PERSONS CARRYING EXPLOSIVES **c51**
Curt David Weinstein, Sidney Weinstein, and Ronald Drozdenko (NeuroCommunication Research Labs., Inc., Danbury, CT.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 759-769 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

Only vapor detection is safe enough to be used to screen persons for carrying explosives into airline terminals, ball games, controlled-access political gatherings, corporate buildings, bus terminals, etc. Although there are many vapor detection techniques available, none, as yet, surpass the following parameters, which are based on a biodetection model -- a specific animal model developed at NCRL. Thus, this biodetection technology becomes the benchmark with which other detection technologies may be judged. The parameters reflect those of NCRL's SYS-5(tm). The 12 parameter model is very general; one expression is NCRL's SYS-5 in which 5 detecting elements are employed in simultaneous independent detection. The detecting element is the rat, a specially prepared rat. Information about the detection behaviors of this detecting element is presented, considering both clean and explosively dirty environments. Derived from text

N93-21932# Naval Research Lab., Washington, DC. Center for Bio/Molecular Science and Engineering.
THE FLOW IMMUNOSENSOR: AN ANTIBODY-BASED SYSTEM FOR EXPLOSIVES DETECTION **c35**
Anne W. Kusterbeck, Frances S. Ligler, and James P. Whelan (Geo-Centers, Inc., Fort Washington, MD.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 770-773 (For primary document see N93-21856 07-03)
Avail: CASI HC A01/MF A10

A dramatic need exists in the transportation industry for a rapid detection system which can readily differentiate explosive materials in complex environments. This need for explosives detection was the major impetus for development of a biologically-based detector (biosensor) at the Center for Bio/Molecular Science and Engineering at the Naval Research Laboratories in Washington, D.C. Designed to minimize analysis time and provide a means to examine multiple samples rapidly, the continuous flow detection system relies on an immobilized antibody molecule for its high specificity and high sensitivity. Unlike traditional antibody-based assay systems, the flow immunosensor does not require long sample incubation periods. In addition to the immobilized antibody, the prototype system consists of fluorescent target molecules, a portable, off-the-shelf fluorimeter, a laptop computer, a small peristaltic pump, and the associated tubing and hardware. Derived from text

N93-21933# Defence Research Agency, Seveuales (England).
EXPLOSIVES SEARCH DOGS **c51**
Stan Lovett *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 774-775 (For primary document see N93-21856 07-03)
Avail: CASI HC A01/MF A10

The use of dogs in detecting explosives is discussed. The following topics are discussed: training, breeds, the olfactory epithelium, olfactory perception, and bioelectricity. CASI

N93-21934# Science Applications International Corp., Santa Clara, CA.
BOMB/NO BOMB: FROM MULTIVARIATE ANALYSIS TO ARTIFICIAL NEURAL SYSTEMS **c35**
Patrick Shea, Felix Liu, and Barak Yedidia *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 777-786 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

Systems for the detection of explosives hidden in checked airline baggage have been under development at the Science Applications International Corporation (SAIC) for the FAA since 1985. In May of 1987, the first prototype was fielded for testing at San Francisco International Airport. In 1989, the first production unit was field at JFK Airport in New York. Since than, over 550,000 bags have been screened by SAIC units around the world. The system uses thermal neutron activation (TNA) to detect the presence of explosives. In this technique a suitcase on a conveyor belt moves past a source and an array of detectors. Neutrons from the source easily penetrate the luggage, and are absorbed by all of the materials present. Different elements will emit different energy gamma rays after absorbing these neutrons (much like fluorescence). These gamma rays are of a high enough energy that they easily penetrate the luggage, and are detected by a detector array which surrounds the cavity enclosing the suitcase and conveyor belt. The detectors record the number of gamma rays observed at each energy. The number of gamma rays of a characteristic energy which are observed depends on the amount of the element present, its location, the number of neutrons present, and the probability that the element will capture a thermal neutron and emit the gamma ray. Since this probability is a known constant for any particular element, and the number of neutrons present and the number of characteristic gamma rays are measured, the amount of each element and its location can, in theory, be determined from the array of signals. Commercial and military explosives, such as are used by terrorists, have several characteristics which distinguish them from most objects in luggage. On of these characteristics is a high density of nitrogen. A description of the decision algorithms is presented, and the artificial neural system (ANS) is discussed. On-line experience and decision surfaces are also covered. Derived from text

N93-21935# California Univ., Berkeley. Dept. of Nuclear Engineering.
A NOVEL APPROACH TO DESIGN OPTIMIZATION OF NUCLEAR-BASED EXPLOSIVE DETECTION SYSTEMS
E. Greenspan, Joseph Bendahan (Science Applications International Corp., Santa Clara, CA.), and Tsahi Gozani (Science Applications International Corp., Santa Clara, CA.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 787-809 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

The Explosive Detection Systems (EDS) under consideration use neutron or photon sources for probing the explosive material. For the sake of abbreviation, we shall refer explicitly only to EDS driven by neutron sources. The design optimization methodology to be described is applicable, nevertheless, to EDS driven by photon sources, as well as by a combination of photon and neutron sources. The design of an EDS is a complicated multidisciplinary process. The present paper focuses on the nuclear design discipline. The goals of the nuclear design are defined in section 2. Section 3 reviews the conventional approach to the nuclear design of EDS while section 4 describes the design approach we are proposing to develop. A limited number of illustrations of the usefulness of the proposed optimization method are presented in section 5. A program plan for the development of a powerful three-dimensional nuclear design optimization capability is outlined in section 6. Derived from text

N93-21936# Imatron Industrial Products, Inc., Foster City, CA.
ASSESSING THE OPERATIONAL IMPACTS OF CHECKED LUGGAGE SCREENING
Steve H. Wolff *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 810-824 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

Several technologies are currently under development to more reliably detect explosives and speed up the inspection of checked luggage. However, the operational effects and benefits of equipment selection and deployment are still under debate. The computational model described in this paper provides insights into security operations by analyzing the entire passenger luggage security screening process. In this way, it is possible to determine parameters that will be important in selecting technologies and configurations to improve security while minimizing operational impact. Additional work that links the cost (both in terms of equipment investment and on-going operational costs) of security measures is under way but is not discussed here. This paper presents the theory behind the computational model, briefly discusses the data used, and presents two examples to illustrate how the model can evaluate the impact of different security strategies and novel scanning technologies. Derived from text

N93-21937# Science Applications International Corp., Santa Clara, CA.
FAST NUCLEAR SPECTROSCOPY FOR EXPLOSIVE DETECTION SYSTEMS **c25**
Peter Ryge, R. Benetti, A. Patel, and E. Chou *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 825-839 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

The requirements for rapid and precise analysis in nuclear-based explosive detection systems pose special spectroscopy problems. Sufficient data must be acquired so that adequately low statistical errors are obtained in a sufficiently short time to meet inspection throughput requirements. In practice, this generally means that these systems employ many detectors, each having very high signal rates. Complex signal processing in each of many channels requires careful design attention to reliability considerations so that inspection system availability demands can be met. In the Thermal Neutron Analysis (TNA) system, the primary information is a very low rate, high energy gamma ray (10.8 MeV) combined with a high rate at lower energies, producing a pile-up background at the energy of interest. This background is one of the principal factors limiting system performance. To overcome these problems, a high counting rate signal processor utilizing time variant filtering was developed. Since the more common counting mode pile-up rejector did not improve the pile-up characteristics of the system significantly, a more effective pile-up rejector based on pulse length inspection was used. Derived from text

N93-21938# Science Applications International Corp., Santa Clara, CA.
COMPUTER SIMULATIONS AND PERFORMANCE PREDICTIONS FOR EXPLOSIVE DETECTION SYSTEMS **c61**
Joseph Bendahan, E. Elias, Z. Shayer, J. Pierre, E. Altschuler, and Tsahi Gozani *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 840-849 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

In the design of nuclear based explosive detection systems (EDS), optimization techniques play an important role. These assist in the design of a system with maximum performance at a minimum cost, size, and weight. A complete and validated model is required to efficiently probe the large parameter space of possible EDS designs, and to quantify the ultimate explosive discrimination performance for changes in system parameters. The objective of such a model is to calculate a large number of design tradeoffs and to quantify the impact on performance of each design configuration without the need for a full experimental verification. This considerably reduces the extent and cost of the design, and makes possible the production of a highly optimized explosive detection system. For nuclear systems based on neutrons as the probing radiation, the neutron flux in the interrogation area should be optimized to yield a maximum figure of merit (FOM). The selection of detector type, size, location, and other parameters should also be modeled and optimized to improve the imaging capabilities, and ultimately the overall system performance. In this paper, the tools and procedures employed by SAIC for optimizing its EDS based on neutron irradiation (TNA and PFNA) are presented. Derived from text

N93-21939# North Carolina Agricultural and Technical State Univ., Greensboro. Dept. of Electrical Engineering.
RECOGNITION OF PARTIALLY OCCLUDED THREAT OBJECTS BASED ON HYBRID HOPFIELD NEURAL NETWORK **c61**
Jung Hyoun Kim, E. H. Park, C. Ntuen, and Shiu M. Cheung (Federal Aviation Administration, Atlantic City, NJ.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 850-859 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

A method for recognizing occluded objects based on neural network approach has been presented. Features such as angle and distance which are invariant under rotational and translational changes are used for the robust description of the shape. Experimental results show that HHN gives a reliable matching of the corresponding segments between two objects. The method eliminates possibility of matching for a part of an object to be matched to similar segments in a different object by finally adjusting states of neurons. We conclude that HHN is a robust approach to solve the two-dimensional occlusion problems. Derived from text

N93-21940# Sandia National Labs., Albuquerque, NM.
SEGMENTATION OF X RAY IMAGES USING PROBABILISTIC RELAXATION LABELING **c35**
Tan Q. Thai *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 860-871 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

The paper presents a method of segmenting x-ray baggage images using probabilistic relaxation labeling (PRL). To compensate for the bias in estimating the compatibility coefficients, we propose the use of two different sets of coefficients for two update passes. These coefficients can be estimated off-line from a number of baggage images instead of on-line from the examined image as proposed in various literature. For a two-class problem, it is shown that all computation of the PRL method can be implemented with look-up tables and a convolver. Using a real-time convolver that processes at a rate of 30 image frames/second, the PRL process can be done under one second. In addition, the algorithm can also be extended to segment contrabands based on other features such as color, texture, volume density, shape, and size. Author

N93-21941# Carnegie-Mellon Univ., Pittsburgh, PA. Robotics Inst.
ROBOTIC SYSTEMS FOR DEPLOYMENT OF EXPLOSIVE DETECTION SENSORS AND INSTRUMENTS **c35**
Melvin W. Siegel, A. M. Guzman, and W. M. Kaufman *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology

May 1992 p 873-879 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

We have described a concept for using robotic systems to deploy and to evaluate objectively the effectiveness of sensors and instruments for detection of contraband explosives, particularly as they might be employed by terrorists against commercial aviation. The system architecture divides the problem into four levels: measurement, manipulation, mobility, and monitoring. Derived from text

N93-21942# Science Applications International Corp., McLean, VA.
A SYSTEMS APPROACH TO THE EXPLOSIVE DETECTION PROBLEM
Michael Claude Smith and Roger Lyn Hoopengardner *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 880-890 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

After the tragic bombing of Pan Am Flight 103, the FAA accelerated research efforts, leading to early fielding of thermal neutron analysis (TNA) systems. While TNA met the initial FAA specifications, evidence from the Pan Am 103 bombing indicates that smaller amounts of explosive than originally specified must be detected. However, TNA testing for smaller amounts of explosives yields higher than desirable false positive rates. Most experts agree that TNA is currently the only true explosive detection technology available, but, to provide an effective system with acceptable false alarm rates, TNA may need to be supplemented with other detection devices, methods, and procedures. Recently, the FAA Technical Center began considering different combinations of technology and procedures that could provide acceptable detection and false alarm rates. Since most people agree that TNA is likely to be a part of any system fielded, SAIC elected to take an overall systems approach to the problem, seeking to develop a method or procedure to evaluate 'systems of systems' comprised of TNA and other technologies and procedures. We studied the problem; developed logical measures of effectiveness (MOE); designed, constructed, validated, and exercised an explosive detection system (EDS) simulation model; and briefed results to the FAA Technical Center's Aviation Security Research Service. The resulting PC-based computer simulation model was designed to be simple to understand, logically correct, and capable of providing meaningful visual displays of the results. This paper describes the computer simulation that was developed. The paper also suggests some enhancements that could be made to increase the fidelity of the simulation and other ways to use a systems analysis approach to improve security. Derived from text

N93-21943# Veterans Administration Hospital, Philadelphia, PA.
INTEGRATION OF THE HUMAN, CANINE, MACHINE INTERFACE FOR EXPLOSIVES DETECTION
J. W. Ternes and A. M. Prestrude (Virginia Polytechnic Inst. and State Univ., Blacksburg.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 891-902 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

The technology of terrorism has outpaced airport security. A recent review of airport bomb detection technologies (Yeaple. 1991) indicated that the metal detecting and x-ray devices currently in place are not capable of detecting plastic explosives. Though there is a new generation of devices which promise to significantly improve detection of explosives, many of these devices are still in development and prototype stages. Further, most of these devices are large, fixed-base, and expensive. There is however, a technology which is mobile, relatively inexpensive, and has been field tested under a wide variety of conditions for many years. That, of course, is the dog/human-handler explosives detector team. Recently, Public Law 101-45 mandated that the FAA review its explosives detection procedures and initiate research to evaluate various forms of explosives detector dog teams. This paper reviews that technology and suggests research which would allow its integration with machine technologies. Derived from text

N93-21944# Science Applications International Corp., Santa Clara, CA.
LOGISTICS AND THE 'ILITIES' REQUIREMENTS FOR EXPLOSIVE DETECTION SYSTEMS
Russell L. Cole and Gerald V. Brown *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 903-910 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

For purposes of this paper, Explosive Detection Systems (EDS) will include Thermal Neutron Analysis (TNA), Fast Neutron Analysis (FNA), Pulsed Fast Neutron Analysis (PFNA), and Gamma Resonances. These techniques, either by virtue of demonstrated performance or from their promise based on preliminary findings, are all accepted explosive detection techniques. These techniques all share common characteristics. They are expensive, both to acquire and to operate. They are large. They incorporate complicated technology. The technology they use is unique. How then, in the face of these seemingly insurmountable challenges, do we design and develop systems and equipment that meet our needs as companies, agencies, governments, and as a people? The answer lies not in panaceas or miracle cures. This paper will offer, at least as a partial solution, an approach utilizing proven methods across a broad spectrum of techniques and a recognition that the success of these efforts lies in your individual creativity and ingenuity. Derived from text

N93-21945# Science Applications International Corp., Santa Clara, CA.
IMPACT ON THE AIR CARRIER OF EXPLOSIVE DETECTION SYSTEMS
Diane Hsiung, Patrick Shea, and Mala Sivakumar *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 911-920 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

In addition or improvement of security, screening measures will have an impact on air carrier operations. This impact must be at least planned for, and preferably evaluated to optimize the choice of systems and procedures to be used. In order to do this, an economic model has been constructed which allows for the comparison of different technologies and procedures on a common basis. This paper describes the application of this model to one specific case. In this case, different x-ray technologies are compared to see which ones are most useful as a 'secondary' screening for explosives in checked luggage. The different x-ray technologies are placed between a Thermal Neutron Analysis (TNA, the 'primary' screening system) and an arbitrary ('tertiary' screening system (here taken as hand searching of the luggage). All of the alternative x-ray systems are operated at the same detection rate; and system performance information is used to predict how many bags are rejected to the tertiary screening for final examination. Note that this is just the specific case under study; the same modeling techniques can be applied to combinations of other systems to lead to a coherent evaluation of the relative merits. Derived from text

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N93-19966# Federal Aviation Administration, Atlantic City, NJ.
A SIMULATION STUDY OF THE EFFECTS OF COMMUNICATION DELAY ON AIR TRAFFIC CONTROL Final Report, Nov. 1989 - Aug. 1990
Eric D. Nadler, Robert DiSario, Peter Mengert, E. D. Sussman, and Gerard Spanier Sep. 1992 168 p
(AD-A258593; DOT-VNTSC-FAA-90-5; DOT/FAA/CT-90/6) Avail: CASI HC A08/MF A02

This study was conducted to examine the impacts of voice communications delays characteristic of Voice Switching and ControL System (VSCS) and satellite communications systems on air traffic system performance, controLLer stress and workload, and communications disruptions. To accomplish this a simulation was developed and performed at the Federal Aviation Administration (FAA) Technical Center. The simulation used scenarios constructed from records of Live air traffic at five adjacent Atlanta Air Route Traffic ControL Center (ARTCC) sectors. Nine full performance level air traffic control specialists from the Atlanta ARTCC sectors simulated participated as subjects. Four delay levels were employed corresponding to: current equipment with and without satellite Link, and

VSCS with and without satellite Three Levels of communications workload were used based on 70 percent, 90 percent, and 110 percent of reference values for the actual sectors. VSCS delays were not found to have any statistically significant impact on any measure. Satellite delays were found to be associated with a statistically significant increase in one kind of communication disruption (step-ons) at the highest level of communications workload used in the study. GRA

N93-20164# Federal Aviation Administration, Washington, DC.
NATIONAL AIRSPACE SYSTEM: AIR TRAFFIC CONTROL AND AIRSPACE MANAGEMENT OPERATIONAL CONCEPT NAS-SR-132
William Trent, Thomas Pickerell, and Harold Nelson, Jr. Dec. 1992 291 p
(Contract DTFA01-91-Y-01004)
(DOT/FAA/SE-92/5) Avail: CASI HC A13/MF A03

The NAS has a responsibility to assist in the safe and efficient flow of traffic from departure aerodrome (or entrance to the system) to destination aerodrome (or exit from the system). It provides flight control services in the en route, terminal, and oceanic airspace. It also provides search and rescue services to locate lost aircraft. In order to exercise control of aircraft, the NAS must have information about the expected routes, times, altitudes of flight, and aircraft characteristics. It must also have information about current location, altitude, and track for each participating aircraft in the system. This concept, and the other seven operational concepts, will complete the description of the system requirements as described in the NASSRS. The eight operational concepts are: Communications (NAS-SR-136); Navigation (NAS-SR-134); Monitoring (NAS-SR-133); Maintenance and Support (NAS-SR-137); System Effectiveness (NAS-SR-138); Air Defense and Law Enforcement Surveillance (NAS-SR-135); Flight Planning (NAS-SR-131); and Air Traffic Control and Airspace Management (NAS-SR-132). Author

N93-20582# Federal Aviation Administration, Oklahoma City, OK. Civil Aeromedical Inst.
COMPARISON OF PERFORMANCE ON THE SHIPLEY INSTITUTE OF LIVING SCALE, AIR TRAFFIC CONTROL SPECIALIST SELECTION TEST, AND FAA ACADEMY SCREEN Final Report
Pamela S. DellaRocco, Nelda Milburn, and Henry W. Mertens Nov. 1992 9 p
(AD-A259249; DOT/FAA/AM-92/30) Avail: CASI HC A02/MF A01

This study was conducted to establish norms for ATCS personnel on a group test of intellectual functioning, the Shipley Institute of Living Scale (SILS), to screen subjects for future research on the effects of Air Traffic Control Specialist (ATCS) related stressors on complex task performance. The SILS provides both verbal (Vocabulary) and cognitive performance (Abstraction) measures of general intellectual functioning. The relationship between SILS and performance of ATCS's in the FAA Academy Nonradar Screen Program (NSP) was also assessed. ATCSs undergo a two-stage selection process: (1) the Office of Personnel Management (OPM) Air Traffic Control Specialist Battery and (2) the NSP, a nine-week performance-based screening course at the FAA Academy. The Shipley was administered to three entering groups of new hires (N = 563) upon their arrival at the FAA Academy. SILS scores were converted to estimated WAIS-R Full Scale intelligence scores. The SILS measures were compared to scores on the OPM selection battery and in the NSP. SILS Total, Abstraction, and estimated WAIS-R scores were better predictors of NSP performance than were the SILS Vocabulary Subtest scores. Moderate correlations were found between the final academy score and the SILS and OPM measures. ATCS applicants scored higher on the Abstraction Subtest than the Vocabulary Subtest. ATCSs tend to be above average in intelligence, and tests of cognitive performance tend to be better predictors of overall NSP performance than verbal measures. The normative data can serve as an effective general intelligence screen for subjects involved in ATCS-related research. GRA

N93-20612# Federal Aviation Administration, Atlantic City, NJ.
DATA MULTIPLEXING NETWORK (DMN). PHASE 3: EQUIPMENT OPERATIONAL TEST AND EVALUATION (OT/E) INTEGRATION TEST REPORT
Wayne E. Bell and Phillip P. Hoang Mar. 1993 27 p
(DOT/FAA/CT-TN92/49) Avail: CASI HC A03/MF A01

This test report contains the test results of the Operational Test and Evaluation (OT&E) integration testing of Data Multiplexing Networking (DMN) Phase 3B Commercial Off-The-Shelf (COTS) equipment. The OT&E integration testing was accomplished by conducting unit level tests at the Federal Aviation Administration (FAA) Technical Center, and integration tests at the Air Route Traffic Control Center (ARTCC) in Minneapolis, Minnesota. Based on the test results, it is concluded that the Motorola Codex COTS equipment performed its function of providing data exchange between NAS facilities and is considered qualified for the NAS environment. Author

N93-20749# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Abt. fuer Funkortung und Nachrichtenverarbeitung.
DEVELOPMENT OF A REALTIME DGPS SYSTEM [AUFBAU EINES ECHTZEIT-DGPS-SYSTEMS]
F. Heimberg (Technische Univ., Hanover, Germany.), C. Meier (Technische Univ., Brunswick, Germany.), T. Mueller (Technische Univ., Brunswick, Germany.), and M. Poppe Feb. 1992 43 p In GERMAN
(DLR-Mitt-92-06; ETN-93-92408) Avail: CASI HC A03/MF A01; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

It is shown that the proposal for a standardized, user independent Differential Global Positioning System (DGPS) is realizable. The experimental system is to be the basis for research in the field of the VHF correction datalink, the real time navigation software, and wave propagation effects on the system behavior in an airport scenario. ESA

N93-21004# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Abt. fuer Systemtechnik und Navigation.
FUNDAMENTALS OF ADAPTIVE ANTICIPATION TECHNIQUES FOR THE DETECTION OF THREATENING AIR TRAFFIC CONFLICTS: INVESTIGATION OF THE HORIZONTAL PROXIMITY SITUATION IN THE CASE OF EXPECTED HEADING CHANGES [GRUNDLAGEN DER ERWARTUNGSORIENTIERTEN KONFLIKTVORHERSAGE IM LUFTVERKEHR: UNTERSUCHUNG DES HORIZONTALEN ANNAEHERUNGSVERHALTENS IM FALLE VON ERWARTETEN KURSAENDERUNGEN]
Wilfried Gerling 13 Nov. 1991 69 p In GERMAN
(DLR-Mitt-91-21; ETN-93-91921) Avail: CASI HC A04/MF A01; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

The proposed concept of adaptive short term conflict prediction in air traffic control takes into consideration both actual radar data and known plans or events. The continuation of individual flight tracks is to be predicted on the basis of expected changes in the aircraft flight profiles. Some methods of differing accuracy for the predetermination of the developing horizontal distance between two aircraft are described. The presented prediction methods may serve as a basis for the construction of a rule basis for the purpose of isolating individual pairs of aircraft, which are proceeding towards aerial conflict. ESA

N93-21190*# National Aeronautics and Space Administration, Washington, DC.
CURRENT AND PLANNED USE OF THE NAVSTAR GLOBAL POSITIONING SYSTEM BY NASA
Harold L. Theiss [1993] 8 p
(NASA-TM-108190; NAS 1.15:108190) Avail: CASI HC A02/MF A01

NASA was quick to realize the potential that the Global Positioning System (GPS) had to offer for its many diverse vehicles, experiments and platforms. Soon after the first Block 1 GPS satellites were launched, NASA began to use the tremendous capabilities that they had to offer. Even with a partial GPS constellation in place, important results have been obtained about the shape, orientation and rotation of the earth and calibration of the ionosphere and troposphere. These calibrations enhance geophysical science and facilitate the navigation of interplanetary spacecraft. Some very important results have been obtained in the continuing NASA program for aircraft terminal area operations. Currently, a large amount of activity is being concentrated on real time kinematic carrier phase tracking which has the potential to revolutionize aircraft navigation. This year marks the launch of the first GPS receiver equipped earth-orbiting NASA spacecraft: the Extreme Ultraviolet Explorer and the Ocean Topography Experiment (TOPEX/Poseidon). This paper describes a cross section of GPS-based research at NASA. Author (revised)

N93-21222# Chance (John E.) and Associates, Inc., Lafayette, LA.
INVESTIGATION OF THE REAL-TIME ACCURACY OF THE DGPS METHOD Final Report, Feb. - Sep. 1992
Dariusz Lapucha and Kurtis L. Maynard Nov. 1992 37 p
(Contract DAAL03-91-C-0034)
(AD-A257692; TEC-0024) Avail: CASI HC A03/MF A01

The Real-Time Differential GPS (DGPS) method using the C/A code (not carrier) has the potential to provide positional accuracy to 1-3 meters (1 delta). DGPS is a viable option for positioning tasks in hydrographic surveying. Determination of the real-time DGPS accuracy is the main objective of this study. Accuracy provided by DGPS may deteriorate depending upon operational conditions. Factors influencing DGPS accuracy are discussed. Background of the DGPS method is given including mathematical description, but emphasis is on general concepts and discussion of DGPS error sources. DGPS implementation problems are discussed. Specific realtime data links and their throughput are analyzed. The RTCM-104 standard for meter level DGPS applications and the different DGPS systems used in the study are discussed. The analysis is performed using real-time and post-processed DGPS results. The influence of two major factors affecting the DGPS accuracy, distance from the monitor station and data rate of differential corrections, is investigated. The role of the data rate is evaluated using simulated data rate scenarios. Particular attention is given to the impact of Selective Availability (SA) on meter level DGPS performance during specific days of heavy SA. GRA

N93-21671# Software Productivity Consortium, Herndon, VA.
DOMAIN ENGINEERING VALIDATION CASE STUDY: SYNTHESIS FOR THE AIR TRAFFIC DISPLAY/COLLISION WARNING MONITOR DOMAIN VERSION 01.00.03
Neil Burkhard, Jeff Facemire, Grady Campbell, Jim OConnor, and Steve Wartik Nov. 1992 375 p
(Contract MDA972-92-J-1018)
(AD-A259407; SPC-92050-CMC) Avail: CASI HC A16/MF A03

This case study exemplifies Synthesis guidance, as provided in the 1991 Synthesis Guidebook (SPC 1991c), and its application to the Air Traffic Display/Collision Warning Monitor (ATD/CWM) domain. The synthesis guidance will be one volume of the 1992 guidebook for reuse-driven software development processes. Both domain engineering and application engineering work products are covered. Even though the Synthesis reuse process is an iterative process, this case study presents only the work products of the final iteration. This case study provides some discussion of how these work products were refined or evolved from previous versions. The case study helps line engineers and technologists understand the application of the Synthesis reuse-driven software development process by providing examples of the work products created by applying Synthesis to a particular domain constituting a business area focus. In this context, a domain is a set of applications. Derived from text

N93-21759# Princeton Economic Research, Inc., NJ.
PRELIMINARY STUDIES OF PLANNING AND FLIGHT STRIP USE AS AIR TRAFFIC CONTROLLER MEMORY AIDS Report, Nov. 1991 - May 1992
Carolina Zingale, Stan Gromelski, and Earl S. Stein Sep. 1992 97 p
(Contract DTFA03-89-C-00050)
(DOT/FAA/CT-TN92/22) Avail: CASI HC A05/MF A02

Preliminary studies were conducted with novice participants (aviation students) to investigate the effects of memory strategies (planning and flight strip management) on Air Traffic Control (ATC) performance. Participants were trained to use TRACON 2, an ATC simulator for the personal computer, and were then tested in three experiments. The first two experiments tested whether having an opportunity to plan control strategies and having increased planning time influenced performance. The results did not indicate that performance improved under these conditions. Individuals differed widely in their performance regardless of test condition, suggesting that individual strategies may have influenced performance to a greater extent than did the test conditions. Methods which allow for the analysis of individual strategies should be used to conduct future research in these areas. The third experiment tested the effect of flight strip management (note writing) on performance and on memory for critical information. Correlations revealed that participants who wrote more on strips tended to perform better and also tended to remember more of the commands they had issued to aircraft, suggesting an important role for active flight strip manipulation. Overall, this work demonstrated that a PC-based simulator can provide a suitable environment in which to test issues in ATC. Realistic scenarios can be developed to accommodate a range of performance abilities, making this a potentially suitable testing device for use with actual air traffic controllers. Author

N93-20453# National Space Development Agency, Ibaraki (Japan). Tracking and Control Center.
RESEARCH ON GPS UTILIZATION IN SPACE [GPS NO UCHUU RIYOU NO KENKYUU]
Atsushi Tsuchiya and Shinichi Ishikawa *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 195-200 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A02/MF A03

N93-21413*# Lockheed Engineering and Sciences Co., Houston, TX.
APPLICABILITY OF RELATIVE GPS TO AUTOMATED RENDEZVOUS BETWEEN THE SPACE SHUTTLE AND SPACE STATION Abstract Only
Fred D. Clark and Ann Christofferson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 8 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21417*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
OFFICE OF SPACEFLIGHT STANDARD SPACEBORNE GLOBAL POSITIONING SYSTEM (GPS) USER EQUIPMENT PROJECT Abstract Only
Penny E. Saunders *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 11-12 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21426*# Mayflower Communications Co., Inc., Reading, MA.
AUTONOMOUS RECONFIGURABLE GPS/INS NAVIGATION AND POINTING SYSTEM FOR RENDEZVOUS AND DOCKING Abstract Only
Triveni M. Upadhyay *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 18 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.For land transportation vehicles see *85 Urban Technology and Transportation.*

N93-20245# General Accounting Office, Washington, DC. National Security and International Affairs Div.
REPORT TO THE CHAIRMAN, LEGISLATION, AND NATIONAL SECURITY SUBCOMMITTEE, COMMITTEE ON GOVERMENT OPERATIONS, HOUSE OF REPRESENTATIVES. UNMANNED AERIAL VEHICLES: MORE TESTING NEEDED BEFORE PRODUCTION OF SHORT-RANGE SYSTEM
Sep. 1992 14 p
(AD-A259473; GAO/NSIAD-92-311) Avail: CASI HC A03/MF A01

The Short-Range Unmanned Aerial Vehicle (UAV) program is reviewed to determine whether it represents a valid joint-service effort that will minimize duplication among UAV programs and whether test results justify the imminent commitment to system production. The system's readiness for production is discussed. The in-depth evaluation is expected to be completed early next year and will focus on the detailed results of system testing as well as the joint-service aspects of the program. GRA

N93-20560# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
AN INVESTIGATION OF DISCOVERY-BASED LEARNING IN THE ROUTE PLANNING DOMAIN M.S. Thesis

Freeman A. Kilpatrick, Jr. Dec. 1992 148 p
(AD-A259141; AFIT/GCE/ENG/92D-07) Avail: CASI HC A07/MF A02

This thesis presents MAVERICK, a Discovery-Based Learning (DBL) system designed to learn maneuvers in the route planning domain. DBL was originally designed to learn in domains for which little domain knowledge exists. This thesis proposes using it in domains for which knowledge exists, but the acquisition of this knowledge is difficult or time-consuming because of the knowledge acquisition bottleneck. The operation of the DBL process in MAVERICK was investigated to determine the potential utility of such a system to a real-world Air Force problem in the domain of aircraft route planning. MAVERICK worked well in its limited domain, and demonstrated several positive aspects of the DBL process, specifically robustness, flexibility, and graceful degradation. Some negative aspects of the process were also encountered during this research; MAVERICK demonstrated a pronounced tendency towards unpredictability, both in its operation and its development. This likely precludes DBL from application to critical systems, however the positive aspects suggest DBL can have potential utility to other systems. GRA

N93-20575# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

THE INFLUENCE OF STRUCTURAL OPTIMIZATION ON THE AEROELASTIC PROPERTIES OF A VERTICAL TAIL M.S. Thesis

David G. Miller Dec. 1992 149 p
(AD-A259140; AFIT/GAE/ENY/92D-24) Avail: CASI HC A07/MF A02

The purpose of this thesis is to investigate the influence of structural optimization parameters on the structural and aeroelastic behavior of a vertical tail. The outside geometry of the tail is assumed to be fixed. The objective of the optimization is to reduce the structural member sizes so that the overall weight of the tail is minimized. The influence that design loads, design constraints, and design variable linking have on the optimal design is observed by examining several design cases. The static aeroelastic properties and flutter speeds of the various design cases are then compared. The doublet lattice method is used to calculate the steady and unsteady subsonic aerodynamic loads and finite element theory is used to model the vertical tail structure. GRA

N93-20579# PPG Industries, Inc., Huntsville, AL. Aircraft Products Div.

T-38 FORWARD WINDSHIELD DEVELOPMENT AND PERFORMANCE DEMONSTRATION REPORT Final Report, Jun. 1982 - Sep. 1989

James W. Myers 12 Mar. 1992 298 p
(Contract F33615-81-C-3403)
(AD-A259240; WL-TR-91-3112) Avail: CASI HC A13/MF A03

According to Air Force information, approximately 500 bird strikes occur each year in Air Training Command (ATC), with over half of these on the T-38. The current windscreen provides some protection at the slower speeds flown during the final phases of the T-38 landing pattern. However, during climbs, cruise, and descents below 10,000-feet the T-38 is normally flown at speeds of 240-to-300 knots which presents a bird strike hazard by larger birds to the pilots. The T-38 low level missions are of particular concern because they are flown at speeds of up to 420-knots. Based on training requirements, the altitude for T-38 low-level missions has decreased to 500-feet above ground level, along with increasing the number of sorties required. Although the Air Force plans student load reductions, the relative number of high-speed, low-level navigation sorties will increase. GRA

N93-20584*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF FLUTTER SUPPRESSION BY PIEZOELECTRIC ACTUATION

Jennifer Heeg Washington Mar. 1993 47 p
(RTOP 505-63-50-15)
(NASA-TP-3241; L-17024; NAS 1.60:3241) Avail: CASI HC A03/MF A01

The objective of this research was to analytically and experimentally study the capabilities of piezoelectric plate actuators for suppressing flutter. Piezoelectric materials are characterized by their ability to produce voltage when subjected to a mechanical strain. The converse piezoelectric effect can be utilized to actuate a structure by applying a voltage. For this investigation, a two-degree-of-freedom wind tunnel model was designed, analyzed, and tested. The model consisted of a rigid wing and a flexible mount system that permitted a translational and a rotational degree of freedom. The model was designed such that flutter was encountered within the testing envelope of the wind tunnel. Actuators made of piezoelectric material were affixed to leaf springs of the mount system. Command signals, applied to the piezoelectric actuators, exerted control over the damping and stiffness properties. A mathematical aeroservoelastic model was constructed by using finite element methods, laminated plate theory, and aeroelastic analysis tools. Plant characteristics were determined from this model and verified by open loop experimental tests. A flutter suppression control law was designed and implemented on a digital control computer. Closed loop flutter testing was conducted. The experimental results represent the first time that adaptive materials have been used to actively suppress flutter. They demonstrate that small, carefully placed actuating plates can be used effectively to control aeroelastic response. Author

N93-20605# Air Force Inst. of Tech., Wright-Patterson AFB, OH. Foreign Aerospace Science and Technology Center.

YIDOYU AND ITS APPLICATION TO AIRCRAFT DESIGN

Xianxue Xun, Qihao Long, Bingchen Pan, and Wenpu Chen 7 Jan. 1993 19 p Transl. into ENGLISH from Hangkong Xuebao (China), v. 12, no. 6, Jun. 1991
(AD-A259262; FASTC-ID(RS)T-0316-92) Avail: CASI HC A03/MF A01

This paper is to introduce the essential techniques, special points, and a sketch on the procedure organization of the multi-constraint design optimization system for aircraft structures (YIDOYU) and also to reintroduce the present status of its systematic applications. From the results of some actual examples, YIDOYU is shown to be a practical design optimization system, with the ability and efficiency to solve different structural optimization problems. GRA

N93-20742# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.

LOAD EXPERIENCE VARIABILITY OF FIGHTER AIRCRAFT

J. B. deJonge 19 Jun. 1989 11 p Presented at Australian Aeronautical Conference, Melbourne, Australia, 9-11 Oct. 1989
(NLR-TP-89172-U; ETN-92-92854) Avail: CASI HC A03/MF A01

A statistical analysis was made of flight load data pertaining to about 10,000 F-104G operational flights. The distributions of load experience per flight could be fairly well approximated by Weibull distribution functions. Specific attention was paid to the differences in load experience per aircraft. Basic aspects of fatigue load monitoring are discussed. ESA

N93-21056# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Military Aircraft Div.

NUMERICAL METHODS FOR AEROTHERMODYNAMIC DESIGN OF HYPERSONIC SPACE TRANSPORT VEHICLES

Klaus Markus Wanie, Alfred Brenneis, Albrecht Eberle, and Stefan Heiss Apr. 1992 16 p Presented at 70th AGARD Fluid Dynamics Panel Symposium on Theoretical and Experimental Methods in Hypersonic Flows, Turin, Italy, 4-8 May 1992
(MBB-FE-211-S-PUB-0481; ETN-93-93427) Copyright Avail: CASI HC A03/MF A01

A pair of numerical methods for predicting the flow past hypersonic vehicle configurations that include wings, fins, flaps, and a propulsion system, are described. The governing equations and fundamental details of the solution methods are reviewed. Results for both geometrically simple test cases and realistic hypersonic configurations are given. Since there is still a considerable lack of experience for hypersonic flow calculations, extensive testing and verification are essential. This verification is done by comparison of results with experimental data and other numerical methods. The results presented prove that the methods used are robust, flexible, and accurate enough to fulfill the needs of the design process. ESA

N93-21305# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Flight Mechanics Panel.

THE TESTING OF FIXED WING TANKER AND RECEIVER AIRCRAFT TO ESTABLISH THEIR AIR-TO-AIR REFUELLING CAPABILITIES, VOLUME 11 [LES ESSAIS PRATIQUES SUR LES AVIONS RAVITAILLEURS ET RAVITAILLES AFIN DE DETERMINER LEURS CAPACITES DE RAVITAILLEMENT EN VOL]

John Bradley (Aircraft and Armament Evaluation Establishment, Boscombe Down, England.) and Karen Emerson (Aircraft and Armament Evaluation Establishment, Boscombe Down, England.) Dec. 1992 27 p *//s* Flight

Test Techniques Series
(AGARD-AG-300-Vol-11; ISBN-92-835-0698-7) Copyright Avail: CASI HC A03/MF A01

Since its founding in 1952, the Advisory Group for Aerospace Research and Development has published, through the Flight Mechanics Panel, a number of standard texts in the field of flight testing. The original Flight Test Manual was published in the years of 1954 to 1956. The Manual was divided into four volumes: (1) performance; (2) stability and control; (3) instrumentation catalog; and (4) instrumentation systems. This AGARDograph therefore describes the points that need to be considered when planning AAR trials to clear a new tanker or a new receiver aircraft for Service use. The paper assumes some familiarity with current AAR practices and equipment. It covers the two AAR systems in widespread use, namely the probe and drogue, and boom refuelling systems. Many of the points that need to be considered are common to both. Derived from text

N93-21310*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A GOVERNMENT/INDUSTRY SUMMARY OF THE DESIGN ANALYSIS METHODS FOR VIBRATIONS (DAMVIBS) PROGRAM
Raymond G. Kvaternik, comp. Jan. 1993 58 p Proceedings of AIAA 33rd Structures, Structural Dynamics and Materials Conference, Dallas, TX, 13-15 Apr. 1992
(RTOP 505-63-36-01)
(NASA-CP-10114; NAS 1.55:10114) Avail: CASI HC A04/MF A01

The NASA Langley Research Center in 1984 initiated a rotorcraft structural dynamics program, designated DAMVIBS (Design Analysis Methods for VIBrationS), with the objective of establishing the technology base needed by the rotorcraft industry for developing an advanced finite-element-based dynamics design analysis capability for vibrations. An assessment of the program showed that the DAMVIBS Program has resulted in notable technical achievements and major changes in industrial design practice, all of which have significantly advanced the industry's capability to use and rely on finite-element-based dynamics analyses during the design process. For individual titles, see N93-21311 through N93-21315.

N93-21311*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THE NASA/INDUSTRY DESIGN ANALYSIS METHODS FOR VIBRATIONS (DAMVIBS) PROGRAM: A GOVERNMENT OVERVIEW
Raymond G. Kvaternik *In its* A Government/Industry Summary of the Design Analysis Methods for Vibrations (DAMVIBS) Program Jan. 1993 p 1-10 Previously announced as A92-34390 (For primary document see N93-21310 07-05)
Avail: CASI HC A02/MF A01

NASA-Langley, under the Design Analysis Methods for Vibrations (DAMVIBS) Program, set out in 1984 to establish the technology base needed by the rotorcraft industry for developing an advanced finite-element-based dynamics design analysis capability for vibrations. Considerable work has been done by the industry participants in the program since that time. Because the DAMVIBS Program is being phased out, a government/industry assessment of the program has been made to identify those accomplishments and contributions which may be ascribed to the program. The purpose of this paper is to provide an overview of the program and its accomplishments and contributions from the perspective of the government sponsoring organization. Author

N93-21312*# Bell Helicopter Co., Fort Worth, TX.
THE NASA/INDUSTRY DESIGN ANALYSIS METHODS FOR VIBRATIONS (DAMVIBS) PROGRAM : BELL HELICOPTER TEXTRON ACCOMPLISHMENTS
James D. Cronkhite *In* NASA. Langley Research Center, A Government/Industry Summary of the Design Analysis Methods for Vibrations (DAMVIBS) Program Jan. 1993 p 11-22 Previously announced as A92-34391 (For primary document see N93-21310 07-05)
Avail: CASI HC A03/MF A01

Accurate vibration prediction for helicopter airframes is needed to 'fly from the drawing board' without costly development testing to solve vibration problems. The principal analytical tool for vibration prediction within the U.S. helicopter industry is the NASTRAN finite element analysis. Under the NASA DAMVIBS research program, Bell conducted NASTRAN modeling, ground vibration testing, and correlations of both metallic (AH-1G) and composite (ACAP) airframes. The objectives of the program were to assess NASTRAN airframe vibration correlations, to investigate contributors to poor agreement, and to improve modeling techniques. In the past, there has been low confidence in higher frequency vibration prediction for helicopters that have multibladed rotors (three or more blades) with predominant excitation frequencies typically above 15 Hz. Bell's findings under the DAMVIBS program, discussed in this paper, included the following: (1) accuracy of finite element models (FEM) for composite and metallic airframes generally were found to be comparable; (2) more detail is needed in the FEM to improve higher frequency prediction; (3) secondary structure not normally included in the FEM can provide significant stiffening; (4) damping can significantly affect phase response at higher frequencies; and (5) future work is needed in the areas of determination of rotor-induced vibratory loads and optimization. Author

N93-21313*# Boeing Helicopter Co., Philadelphia, PA.
THE NASA/INDUSTRY DESIGN ANALYSIS METHODS FOR VIBRATIONS (DAMVIBS) PROGRAM: BOEING HELICOPTERS AIRFRAME FINITE ELEMENT MODELING
R. Gabel, P. Lang, and D. Reed *In* NASA. Langley Research Center, A Government/Industry Summary of the Design Analysis Methods for Vibrations (DAMVIBS) Program Jan. 1993 p 23-34 Previously announced as A92-34392 (For primary document see N93-21310 07-05)
(Contracts NAS1-16460; NAS1-17497)
Avail: CASI HC A03/MF A01

Mathematical models based on the finite element method of structural analysis, as embodied in the NASTRAN computer code, are routinely used by the helicopter industry to calculate airframe static internal loads used for sizing structural members. Historically, less reliance has been placed on the vibration predictions based on these models. Beginning in the early 1980's NASA's Langley Research Center initiated an industry wide program with the objective of engendering the needed trust in vibration predictions using these models and establishing a body of modeling guides which would enable confident future prediction of airframe vibration as part of the regular design process. Emphasis in this paper is placed on the successful modeling of the Army/Boeing CH-47D which showed reasonable correlation with test data. A principal finding indicates that improved dynamic analysis requires greater attention to detail and perhaps a finer mesh, especially the mass distribution, than the usual stress model. Post program modeling efforts show improved correlation placing key modal frequencies in the b/rev range with 4 percent of the test frequencies. Author

N93-21314*# McDonnell-Douglas Helicopter Co., Mesa, AZ.
THE NASA/INDUSTRY DESIGN ANALYSIS METHODS FOR VIBRATIONS (DAMVIBS) PROGRAM: MCDONNELL-DOUGLAS HELICOPTER COMPANY ACHIEVEMENTS
Mostafa Toossi, Richard Weisenburger, and Mostafa Hashemi-Kia *In* NASA. Langley Research Center, A Government/Industry Summary of the Design Analysis Methods for Vibrations (DAMVIBS) Program Jan. 1993 p 35-45 Previously announced as A92-34393 (For primary document see N93-21310 07-05)
Avail: CASI HC A03/MF A01

This paper presents a summary of some of the work performed by McDonnell Douglas Helicopter Company under NASA Langley-sponsored rotorcraft structural dynamics program known as DAMVIBS (Design Analysis Methods for VIBrationS). A set of guidelines which is applicable to dynamic modeling, analysis, testing, and correlation of both helicopter airframes and a large variety of structural finite element models is presented. Utilization of these guidelines and the key features of their applications to vibration modeling of helicopter airframes are discussed. Correlation studies with the test data, together with the development and applications of a set of efficient finite element model checkout procedures, are demonstrated on a large helicopter airframe finite element model. Finally, the lessons learned and the benefits resulting from this program are summarized. Author

N93-21315*# Sikorsky Aircraft, Stratford, CT.
THE NASA/INDUSTRY DESIGN ANALYSIS METHODS FOR VIBRATIONS (DAMVIBS) PROGRAM: SIKORSKY AIRCRAFT: ADVANCES TOWARD INTERACTING WITH THE AIRFRAME DESIGN PROCESS
William J. Twomey *In* NASA. Langley Research Center, A Government/Industry Summary of the Design Analysis Methods for Vibrations

(DAMVIBS) Program Jan. 1993 p 47-56 Previously announced as A92-34394 (For primary document see N93-21310 07-05)
Avail: CASI HC A02/MF A01

A short history is traced of the work done at Sikorsky Aircraft under the NASA/industry DAMVIBS program. This includes both work directly funded by the program as well as work which was internally funded but which received its initial impetus from DAMVIBS. The development of a finite element model of the UH-60A airframe having a marked improvement in vibration-predicting ability is described. A new program, PAREDYM, developed at Sikorsky, which automatically adjusts an FEM so that its modal characteristics match test values, is described, as well as the part this program played in the improvement of the UH-60A model. Effects of the bungee suspension system on the shake test data used for model verification are described. The impetus given by the modeling improvement, as well as the recent availability of PAREDYM, has brought for the first time the introduction of low-vibration design into the design cycle at Sikorsky. Author

N93-21401# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany). Military Aircraft Div.
THE INTEGRATED DESIGN AND MANUFACTURING OF COMPOSITE STRUCTURES FOR AIRCRAFT USING AN ADVANCED TAPE LAYERING TECHNOLOGY
G. Berchtold and J. Klenner (Messerschmitt-Boelkow-Blohm G.m.b.H., Augsburg, Germany.) 22 Jul. 1992 14 p
(MBB-LME-251-S-PUB-0491-A; ETN-93-93433) Copyright Avail: CASI HC A03/MF A01

Since composite technology still suffers form several weak points such as the lack of adequate mechanized tape application techniques for complex compound structures, unsatisfying design methods, and missing continuous computer aided design/computer aided manufacturing linkage that result in long lead times and high production costs, an 'integrated tape laying system' for automated manufacturing of complex parts is described. This system uses a new tape steering technology. The steering technology's potentials and restrictions are integrated completely in the design process to avoid time consuming iteration loops and to optimize the structure. To be able to understand the detailed process, a short overview of the complete aircraft process from design to manufacturing is given. From this, the optimal detailed process is derived, with an important influence from the specific manufacturing technology. Some remarks on economic potentials are outlined in a typical example. ESA

N93-21479# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Produktbereich Militaerflugzeuge.
SELECTION CRITERIA FOR METALLIC HIGH TEMPERATURE STRUCTURAL MATERIALS IN HYPERSONIC FLYING EQUIPMENT [AUSWAHLKRITERIEN FUER METALLISCHE HEISSTRUKTURWERKSTOFFE IN HYPERSCHALLFLUGGERAETEN]
R. Lang and D. Weisgerber 17 Jul. 1992 8 p In GERMAN Presented at Deutscher Luft- und Raumfahrtkongress/DGLR-Jahrestagung 1992, Bremen, Germany, 29 Sep. - 2 Oct. 1992 Submitted for publication
(MBB-LME-221-HYPAC-PUB-2-A; ETN-93-93432) Avail: CASI HC A02/MF A01

It is shown that high mechanical characteristic values and oxidation resistance in total temperature spectra, and manufacturing properties, such as workability and weldability have a primary influence on hypersonic material selection, besides the availability of materials and semiproducts. The selection of materials is to follow a high ranking concept, which takes into consideration the consequences of the combination of various materials. Titanium alloys and superalloys which meet with lightweight construction and manufacturing requirements for high temperature structures were selected among a number of possible metallic materials. ESA

N93-21646*# Colorado Univ., Boulder.
HSCT MISSION ANALYSIS OF WAVERIDER DESIGNS Quarterly Progress Report No. 2, 15 Aug. 1991 - 15 Nov. 1992
15 Nov. 1992 13 p Original contains color illustrations
(Grant NAG1-1295)
(NASA-CR-192193; NAS 1.26:192193; Rept-153-6442) Avail: CASI HC A03/MF A01; 3 functional color pages

In the second quarter the development of the two waverider design tools was continued, and the groundwork necessary for the incorporation of waverider technology into the realm of the High Speed Civil Transports (HSCT's) was laid out. Advances in each of these areas is summarized. Work on the WIPAR code included the addition of an upper surface geometry generator and characteristic flow solver and the inclusion of viscous analysis in the performance computations. Details of these changes are given. In the course of the second project quarter, much of the analysis performed during the first quarter was incorporated into a working computer code. To date, utilities were developed for the definition of arbitrary 3-D shock surfaces, the computation of post-shock flow conditions, and the marching of the solution in a roughly cross-stream direction away from the shock surface. These utilities are briefly described. During the second quarter groundwork for the analysis of complete configurations was initiated. This involved the development of computational utilities for the integration of powerplants with the waverider forebodies, and the acquisition of a number of configuration analysis software packages. Work in these areas is discussed. Derived from text

N93-21762# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany). Abt. Hochgeschwindigkeitsstroemungen.
EXPERIMENTAL INVESTIGATIONS ON WING-BODY COMBINATIONS AND THEIR COMPONENTS AT HIGH ANGLES OF ATTACK IN THE SUBSONIC AND TRANSONIC SPEED RANGE [RUMPF, GESTUTZTER DELTAFLUEGEL, STROEMUNGSABLOESUNG, KRAFT- UND MOMENTTENMESSUNG, INTERFERENZEN]
Klaus Hartmann and S. R. Patil (National Aeronautical Lab., Bangalore, India.) Oct. 1991 86 p
(DLR-FB-91-43; ETN-93-91932) Avail: CASI HC A05/MF A01; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

Documentation and interpretation of experimental results obtained from force and moment measurements on a body of revolution, different cropped delta wings, and their wing body combinations are considered. The experiments were carried out in the transonic wind tunnel. They comprise the Mach number range from 0.5 to 1.2 at angles of attack up to 30 deg. In some cases, the Reynolds number was also varied. The results form a data base which is aimed at the validation and improvement of prediction methods and helps to lead to a better understanding of the complex three dimensional separated flow fields. ESA

N93-21810*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
TEST TECHNIQUES FOR EVALUATING FLIGHT DISPLAYS
Loran A. Haworth and Richard L. Newman Feb. 1993 18 p
(RTOP 505-64-36)
(NASA-TM-103947; A-92139; NAS 1.15:103947; ATCOM-TR-92-A-006; AD-A260295) Avail: CASI HC A03/MF A01

The rapid development of graphics technology allows for greater flexibility in aircraft displays, but display evaluation techniques have not kept pace. Historically, display evaluation has been based on subjective opinion and not on the actual aircraft/pilot performance. Existing electronic display specifications and evaluation techniques are reviewed. A display rating technique analogous to handling qualities ratings was developed and is recommended for future evaluations. The choice of evaluation pilots is also discussed and the use of a limited number of trained evaluators is recommended over the use of a large number of operational pilots.
Author

N93-22003*# Arizona State Univ., Tempe. Coll. of Engineering and Applied Sciences.
DEVELOPMENT OF A NON-LINEAR SIMULATION FOR GENERIC HYPERSONIC VEHICLES - ASUHS1 Interim Task Report
Juan Salas, T. Alan Lovell, and David K. Schmidt Feb. 1993 61 p
(Grant NAG1-1341)
(NASA-CR-192710; NAs 1.26:192710; ARC-93-1) Avail: CASI HC A04/MF A01

A nonlinear simulation is developed to model the longitudinal motion of a vehicle in hypersonic flight. The equations of motion pertinent to this study are presented. Analytic expressions for the aerodynamic forces acting on a hypersonic vehicle which were obtained from Newtonian Impact Theory are further developed. The control surface forces are further examined to incorporate vehicle elastic motion. The purpose is to establish feasible equations of motion which combine rigid body, elastic, and aeropropulsive

dynamics for use in nonlinear simulations. The software package SIMULINK is used to implement the simulation. Also discussed are issues needing additional attention and potential problems associated with the implementation (with proposed solutions). Author (revised)

N93-21124# Canadian Space Agency, Ottawa (Ontario).
ACCELERATION LEVELS ON THE KC-135
Bjarni V. Tryggvason *In its* Spacebound 1991 1991 p 277-282
(For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N93-20163*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
APPLICATION OF A FLUSH AIRDATA SENSING SYSTEM TO A WING LEADING EDGE (LE-FADS)
Stephen A. Whitmore, Timothy R. Moes, Mark W. Czerniejewski, and Douglas A. Nichols Feb. 1993 17 p Presented at the AIAA 31st Aerospace Sciences Meeting, Reno, NV, 11-14 Jan. 1993
(RTOP 505-68-40)
(NASA-TM-104267; H-1886; NAS 1.15:104267; AIAA Paper 93-0634)
Avail: CASI HC A03/MF A01

The feasibility of locating a flush airdata sensing (FADS) system on a wing leading edge where the operation of the avionics or fire control radar system will not be hindered is investigated. The leading-edge FADS system (LE-FADS) was installed on an unswept symmetrical airfoil and a series of low-speed wind-tunnel tests were conducted to evaluate the performance of the system. As a result of the tests it is concluded that the aerodynamic models formulated for use on aircraft nosetips are directly applicable to wing leading edges and that the calibration process is similar. Furthermore, the agreement between the airdata calculations for angle of attack and total pressure from the LE-FADS and known wind-tunnel values suggest that wing-based flush airdata systems can be calibrated to a high degree of accuracy. Static wind-tunnel tests for angles of attack from -50 deg to 50 deg and dynamic pressures from 3.6 to 11.4 lb/sq ft were performed. Author

N93-21259# Naval Air Warfare Center, Patuxent River, MD. Aircraft Div.
SOFTWARE DESIGN DOCUMENT FOR THE GENERIC AVIONICS DATA BUS TOOL KIT
4 Oct. 1992 128 p
(AD-A259329) Avail: CASI HC A07/MF A02

This Software Design Document describes the structure of the Generic Avionics Data Bus Tool Kit (GADBTK), which is part of the Ada Technology Insertion Program's (ATIP) Ada binding project. The Computer Software Configuration Item (CSCI) described in this design document is a collection of related routines that will be combined to form a bus monitor application. The primary goal of the project is to produce reusable data bus software components. GRA

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N93-20109*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
IDENTIFICATION OF PROPULSION SYSTEMS
Walter Merrill, Ten-Huei Guo, and Ahmet Duyar (Florida Atlantic Univ., Boca Raton.) Aug. 1991 32 p Workshop held in Cleveland, OH, 9 Aug. 1991; sponsored by the Ohio Aerospace Institute
(RTOP 506-42-72)
(NASA-TM-106007; E-7171; NAS 1.15:106007) Avail: CASI HC A03/MF A01

This paper presents a tutorial on the use of model identification techniques for the identification of propulsion system models. These models are important for control design, simulation, parameter estimation, and fault detection. Propulsion system identification is defined in the context of the classical description of identification as a four step process that is unique because of special considerations of data and error sources. Propulsion system models are described along with the dependence of system operation on the environment. Propulsion system simulation approaches are discussed as well as approaches to propulsion system identification with examples for both air breathing and rocket systems. Author

N93-20252*# United Technologies Corp., East Hartford, CT.
CREEP FATIGUE LIFE PREDICTION FOR ENGINE HOT SECTION MATERIALS (ISOTROPIC) Interim Report No. 2, Oct. 1985 - Apr. 1987
R. S. Nelson, G. W. Levan, and J. F. Schoendorf Aug. 1992 129 p
(Contract NAS3-23288; RTOP 590-21-11)
(NASA-CR-189220; NAS 1.26:189220; PWA-5894) Avail: CASI HC A07/MF A02

A series of high temperature strain controlled fatigue tests have been completed to study the effects of thermomechanical fatigue, multiaxial loading, reactive environments, and imposed mean stresses. The baseline alloy used in these tests was cast B1900+Hf (with and without coatings); a small number of tests of wrought INCO 718 are also included. A strong path dependence was demonstrated during the thermomechanical fatigue testing, using in-phase, out-phase, and non-proportional (elliptical and 'dogleg') strain-temperature cycles. The multiaxial tests also demonstrated cycle path to be a significant variable, using both proportional and non-proportional tension-torsion loading. Environmental screening tests were conducted in moderate pressure oxygen and purified argon; the oxygen reduced the specimen lives by two, while the argon testing produced ambiguous data. Both NiCoCrAlY overlay and diffusion aluminide coatings were evaluated under isothermal and TMF conditions; in general, the lives of the coated specimens were higher that those of uncoated specimens. Controlled mean stress TMF tests showed that small mean stress changes could change initiation lives by orders of magnitude; these results are not conservatively predicted using traditional linear damage summation rules. Microstructures were evaluated using optical, SEM and TEM methods. Author

N93-20583*# General Motors Corp., Indianapolis, IN. Gas Turbine Div.
INVESTIGATION OF ADVANCED COUNTERROTATION BLADE CONFIGURATION CONCEPTS FOR HIGH SPEED TURBOPROP SYSTEMS. TASK 5: UNSTEADY COUNTERROTATION DUCTED PROPFAN ANALYSIS. COMPUTER PROGRAM USER'S MANUAL Final Report
Edward J. Hall, Robert A. Delaney, John J. Adamczyk, Christopher J. Miller, Andrea Arnone, and Charles Swanson Jan. 1993 211 p
(Contract NAS3-25270; RTOP 535-03-10)
(NASA-CR-187125; NAS 1.26:187125) Avail: CASI HC A10/MF A03

The primary objective of this study was the development of a time-marching three-dimensional Euler/Navier-Stokes aerodynamic analysis to predict steady and unsteady compressible transonic flows about ducted and unducted propfan propulsion systems employing multiple blade rows. The computer codes resulting from this study are referred to as ADPAC-AOACR (Advanced Ducted Propfan Analysis Codes-Angle of Attack Coupled Row). This report is intended to serve as a computer program user's manual for the ADPAC-AOACR codes developed under Task 5 of NASA Contract NAS3-25270, Unsteady Counterrotating Ducted Propfan Analysis. The ADPAC-AOACR program is based on a flexible multiple blocked grid discretization scheme permitting coupled 2-D/3-D mesh block solutions with application to a wide variety of geometries. For convenience, several standard mesh block structures are described for turbomachinery applications. Aerodynamic calculations are based on a four-stage Runge-Kutta time-marching finite volume solution technique with added numerical dissipation. Steady flow predictions are accelerated by a multigrid procedure. Numerical calculations are compared with experimental data for

several test cases to demonstrate the utility of this approach for predicting the aerodynamics of modern turbomachinery configurations employing multiple blade rows. Author

N93-20610# Boeing Military Airplane Development, Seattle, WA.
PROPULSION/WEAPON SYSTEM INTERACTION MODEL Final Report, Dec. 1983 - Sep. 1987
Colin Widdison Jul. 1992 161 p
(Contract F33615-83-C-2347)
(AD-A259291; D180-29760-1; WL-TR-92-2029) Avail: CASI HC A08/MF A02

This document described a computer program used to evaluate the effects of advanced air breathing propulsion systems on aircraft performance. The program is required to determine the potential impact of propulsion technology advancements and future weapon system requirements on propulsion concept and cycle selection. A major requirement in such assessments is the evaluation of interaction effects between the engine and airframe. Several scalable airframe data bases were developed to examine a variety of vehicle concepts, including a tactical fighter, supersonic interceptor, supersonic cruise missile, logistic transport, lightweight fighter, carrier air vehicle (first stage of a two-stage-to-orbit system), and hypersonic interceptor. A program description including options, mission analysis approach, installation methodology, and program structure is provided. A description of each of the existing data bases including baseline weights, dimensions, and drag characteristics is included. Also, a sample output listing is included in this document. GRA

N93-20735# Rolls-Royce Ltd., Derby (England). Aerospace Group.
SATISFYING THE CUSTOMER'S REQUIREMENTS
M. R. Williams 7 Apr. 1992 18 p Presented at Moscow Aero and Industry Engine 1992, Moscow, Russia, 6-12 Apr. 1992
(PNR-90988; ETN-92-92761) Copyright Avail: NTIS HC A03/MF A01

Requirements of customers for civil aeroengines, which have become the design and business philosophies of Rolls-Royce, and which have been applied throughout their heritage resulting in quality engineering, are discussed. These requirements are considered with respect to engineering quality of aeroengines and civil gas turbine engines. The following are discussed: mechanical integrity and reliability, thermal modeling and validation, fan/disc assembly design validation, derivative engine benefits, fan/disc assembly certification requirements, economic operation and environmental responsibility (emissions, noise). The Trent family and Trent 800 is focused upon. The definition and satisfaction of future requirements is discussed. ESA

N93-20773*# General Motors Corp., Indianapolis, IN. Allison Gas Turbine Div.
INVESTIGATION OF ADVANCED COUNTERROTATION BLADE CONFIGURATION CONCEPTS FOR HIGH SPEED TURBOPROP SYSTEMS. TASK 5: UNSTEADY COUNTERROTATION DUCTED PROPFAN ANALYSIS Final Report
Edward J. Hall and Robert A. Delaney Jan. 1993 133 p Original contains color illustrations
(Contract NAS3-25270; RTOP 535-03-10)
(NASA-CR-187126; NAS 1.26:187126) Avail: CASI HC A07/MF A02; 15 functional cor pages

The primary objective of this study was the development of a time-marching three-dimensional Euler/Navier-Stokes aerodynamic analysis to predict steady and unsteady compressible transonic flows about ducted and unducted propfan propulsion systems employing multiple blade rows. The computer codes resulting from this study are referred to as ADPAC-AOARCR (Advanced Ducted Propfan Analysis Codes-Angle of Attack Coupled Row). This document is the final report describing the theoretical basis and analytical results from the ADPAC-AOACR codes developed under task 5 of NASA Contract NAS3-25270, Unsteady Counterrotating Ducted Propfan Analysis. The ADPAC-AOACR Program is based on a flexible multiple blocked grid discretization scheme permitting coupled 2-D/3-D mesh block solutions with application to a wide variety of geometries. For convenience, several standard mesh block structures are described for turbomachinery applications. Aerodynamic calculations are based on a four-stage Runge-Kutta time-marching finite volume solution technique with added numerical dissipation. Steady flow predictions are accelerated by a multigrid procedure. Numerical calculations are compared with experimental data for several test cases to demonstrate the utility of this approach for predicting the aerodynamics of modern turbomachinery configurations employing multiple blade rows. Author

N93-20913# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Moissy-Cramayel (France).
OPTIMIZATION AND SENSITIVITY COMPUTATIONS FOR THE CONCEPTION OF INTERNAL VENTILATION SYSTEM IN THE AIRCRAFT ENGINE
P. Gibert (Groupe Informatique Scientifique et Technique, Sevres, France.), P. Guyon (Groupe Informatique Scientifique et Technique, Sevres, France.), J. Bastart, and Y. Baudry 1991 8 p Presented at GRECO and ENS, Cachan, France, 2-5 Apr. 1991
(ETN-93-93375) Avail: CASI HC A02/MF A01

A description of the physical system, and the state variables is given. The mechanical system is composed of a set of cavities joined by restrictions. The state unknowns of the problem, which characterize the working point when the system is supplied with air, are the temperatures and pressures of cavities and the mass flows of restrictions. Each restriction is characterized by a constitutive law defined by some geometrical and technological parameters. There are two classes of design variables: firstly, these restriction parameters for a subset of restriction; secondly, some given temperatures or pressures at the boundary of the circuit. The aim of optimization is to minimize the inlet mass flow subject to the constraint that the design leads to an adequate ventilation of the circuit. The objective function is generally the inlet mass flow. The constraints functions acting on pressures, temperatures, mass flows or any thermodynamic variable allow building of the admissible set of design variables which assumes an adequate ventilation. The numerical procedure for minimizing the objective function in the admissible set of design variables is analyzed. The state equation of the model is recalled, the sensitivity derivative computations are investigated by adjoint states, and then the optimization and numerical examples are introduced. ESA

N93-21173# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Abt. Flugmechanik der Drehfluegelflugzeuge.
THE INFLUENCE OF THE ROTOR TEST FACILITIES ROTEST AND ROTOS ON THE ROTOR INFLOW [UEBER DEN EINFLUSS DER ROTORVERSUCHSSTAENDE ROTEST UND ROTOS AUF DIE ROTORDURCHSTROEMUNG IM DNW]
Berend vanderWall and Christian Goepel Jun. 1991 48 p In GERMAN
(DLR-Mitt-91-16; ETN-93-91917) Avail: CASI HC A03/MF A01; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

Rotor simulation calculations made in connection with rotor tests in the DNW (German/Dutch windtunnel), using the test facilities ROTEST (Rotor Test Stand) and ROTOS (Rotor On String), are presented. The models describing the induced velocities at the rotor blades influenced rotor performance and rotor dynamics, by affecting the aerodynamic loads. The calculations were made using an incompressible panel method and the results were dependent on the rotor shaft tilt and on tunnel speed. It appeared necessary to have the induced flow of the test stands included in rotor simulation at tunnel speed higher than about 30 m/s, whereas the self induced velocities were more dominant at lower speed. ESA

N93-21210*# Purdue Univ., Indianapolis, IN. School of Mechanical Engineering.
APPLICATIONS OF ACTIVE ADAPTIVE NOISE CONTROL TO JET ENGINES Final Report, 1 Mar. 1992 - 28 Feb. 1993
Rahmat Shoureshi and Larry Brackney 8 Mar. 1993 17 p
(Grant NAG3-1272)
(NASA-CR-192277; NAS 1.26:192277) Avail: CASI HC A03/MF A01

During phase 2 research on the application of active noise control to jet engines, the development of multiple-input/multiple-output (MIMO) active adaptive noise control algorithms and acoustic/controls models for turbofan engines were considered. Specific goals for this research phase included: (1) implementation of a MIMO adaptive minimum variance active noise controller; and (2) turbofan engine model development. A minimum variance control law for adaptive active noise control has been developed, simulated, and implemented for single-input/single-output (SISO) systems. Since acoustic systems tend to be distributed, multiple sensors, and actuators

are more appropriate. As such, the SISO minimum variance controller was extended to the MIMO case. Simulation and experimental results are presented. A state-space model of a simplified gas turbine engine is developed using the bond graph technique. The model retains important system behavior, yet is of low enough order to be useful for controller design. Expansion of the model to include multiple stages and spools is also discussed. Derived from text

N93-21288# European Space Agency, Paris (France).
THERMODYNAMIC FLOW DESCRIPTION OF A RAMJET FOR DETERMINATION OF ENGINE FORCES AND MOMENTS [THERMODYNAMISCHE STROEMUNGSBESCHREIBUNG EINES STAUSTRAHLTRIEBWERKS MIT UNTERSCHALLVERBRENNUNG ZUR BESTIMMUNG DER TRIEBWERKSKRAEFTE UND MOMENTE]
Frans G. J. Kremer Aug. 1992 180 p Transl. into ENGLISH of Thermodynamische Stroemungsbeschreibung Eines Staustrahltriebwerks mit Unterschallverbrennung zur Bestimmung der Triebwerkskraefte und Momente (Cologne, Germany, DLR), Jan. 1991 155 p Original language document was announced as N91-32139
(ESA-TT-1266; DLR-FB-91-02; ETN-93-93081) Avail: CASI HC A09/MF A02; original German version available from DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

A theoretical ramjet model for calculation purposes is described. The model is used for performance calculations on a supersonic flight vehicle (Mach numbers between 3 and 7). The forces and moments in the ramjet have to be determined for these performance calculations. The engine forces and moments are determined from flow conditions ascertained at characteristic planes within the engine. The conditions applied and assumptions used are described. It is important to clarify which forces are specific to the engine and which forces are specific to the flight body, a process referred to as 'bookkeeping'. Estimates of the order of value of the factors influencing the ramjet engine are made. The computer program produced for the work permits parameter variations which provide insight into the relationships and interactions of the individual parameters. ESA

N93-21316 Aeronautical Research Labs., Melbourne (Australia).
FIELD EVALUATION OF SIX PROTECTIVE COATINGS APPLIED TO T-56 TURBINE BLADES AFTER 2000 HOURS OF ENGINE USE Technical Report No. 2
S. G. Russo Nov. 1992 38 p Original contains color illustrations
(ARL-TR-2; AR-007-113) Copyright Avail: Issuing Activity

The first-stage high-pressure turbine blades in RAAF T-56 engines have a rejection rate which is unacceptably high. It was revealed that the current coating, a conventional nickel aluminide, has a greater than 60 percent rejection rate after 2000 hours. Consequently, a trail program was established to assess the benefits of five alternative protective coatings and to determine which coatings, if any, could withstand up to 3000 engine operating hours. A previous report demonstrated the potential of platinum and platinum/rhodium modified aluminides after 1500 hours of engine operation. This report, after approximately 2000 hours of service, supports the previous recommendations that the precious metal aluminides offer superior resistance to hot corrosion than the conventional aluminides and chromium-modified aluminides. The inability of the silicon-modified aluminide to form an evenly distributed coating over the entire blade renders it unsuitable.
Author (revised)

N93-21459# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Evry (France).
SUPERSONIC TRANSPORT: WHICH MATERIAL FOR THE ENGINE [TRANSPORT SUPERSONIQUE: QUELS MATERIAUX POUR LE MOTEUR]
A. Lasalmonie and P. Saillot (Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Moissy-Cramayel, France.) 1991 16 p In FRENCH Presented at AAAF 39th Salon International de Paris on Materiaux pour l'Aeronautique, Le Bourget, France, 14-23 Jun. 1991
(DS-2023; ETN-93-93393) Avail: CASI HC A03/MF A01

Materials proposed to assure the functioning of MCV99, an aircraft engine to replace that of the Concorde, are examined. The aim is that this engine should consume less fuel and cause less noise and air pollution. The principles of functioning of this engine are considered together with the material problems of supersonic engines. The resistance of nickel superalloys and high temperature composites are discussed and the specific bending strength of glass matrix composites are compared. The engine parts which will be made of the new materials are indicated. The thermal stability of composite materials, which may be used for the engine casing and fixed parts, are indicated. The creep strength of materials to be used for discs and blades at temperatures less than 600 C, for example titanium alloys, and SiC/Ti are discussed together with materials to be used at temperatures greater than 600C (nickel superalloys). The use of a nickel alloy or a SiC/Ti composite is proposed for the turbine shaft where temperatures of 500 C will be attained. ESA

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N93-19960*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
GUIDANCE AND FLIGHT CONTROL LAW DEVELOPMENT FOR HYPERSONIC VEHICLES Progress Report No. 3, 5 Jul. 1992 - 31 Jan. 1993
A. J. Calise and N. Markopoulos Jan. 1993 41 p
(Grant NAG1-1257)
(NASA-CR-192102; NAS 1.26:192102) Avail: CASI HC A03/MF A01

During the third reporting period our efforts were focused on a reformulation of the optimal control problem involving active state-variable inequality constraints. In the reformulated problem the optimization is carried out not with respect to all controllers, but only with respect to asymptotic controllers leading to the state constraint boundary. Intimately connected with the traditional formulation is the fact that when the reduced solution for such problems lies on a state constraint boundary, the corresponding boundary layer transitions are of finite time in the stretched time scale. Thus, it has been impossible so far to apply the classical asymptotic boundary layer theory to such problems. Moreover, the traditional formulation leads to optimal controllers that are one-sided, that is, they break down when a disturbance throws the system on the prohibited side of the state constraint boundary. Author

N93-20039*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
APPARATUS AND METHOD FOR IMPROVING SPIN RECOVERY ON AIRCRAFT Patent Application
H. Paul Stough, II, inventor (to NASA) 21 Sep. 1992 13 p
(NASA-Case-LAR-14747-1; NAS 1.71:LAR-14747-1;
US-Patent-Appl-SN-948057) Avail: CASI HC A03/MF A01

Previous research on airplane spinning and recovery has shown that at potential spin conditions (high angles of attack with rotation) the horizontal tail, depending upon its location, can create a wake about the vertical tail and rudder which can adversely affect airplane spin and recovery characteristics. Many methods of altering the tail geometry to modify these interference effects have been investigated for improving airplane spin and recovery characteristics. Examples of changes includes relocation of the horizontal tail, increasing control surface travel, and use of a 'flip tail' that can be rotated to extreme angles for spin recovery. A device is provided which improves the spin recovery characteristics of aircraft which involves attaching the horizontal tail of the aircraft to the aircraft such that a gap remains between the root end of each horizontal tail section and the fuselage or vertical tail of the aircraft. The gaps measure between about 15 and 30 percent of the tail semispan. The gaps may be covered by shields which are released should a spin occur. NASA

N93-20296*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
RESEARCH IN ROBUST CONTROL FOR HYPERSONIC VEHICLES Progress Report No. 1, 1 Jul. - 30 Nov. 1992
A. J. Calise and H. Buschek Nov. 1992 45 p
(Grant NAG1-1451)
(NASA-CR-192127; NAS 1.26:192127) Avail: CASI HC A03/MF A01

During the first reporting period research concentrated on finishing the

modeling work required for a representative model of a scramjet propulsion system for hypersonic vehicles. An existing hypersonic propulsion code was adjusted to the winged-cone configuration. In this process the complete force and moment calculation was revised. The advantageous feature of the code to account for angle of attack variations was then used to compute the thrust, lift, and pitching moment contributions of the propulsion system not only for various Mach numbers and fuel equivalence ratios, but also for different angles of attack. Author

N93-20551# Wright Lab., Wright-Patterson AFB, OH.
URV FLIGHT TEST OF AN ADA IMPLEMENTED SELF-REPAIRING FLIGHT CONTROL SYSTEM Final Report, 1 Jan. 1985 - 31 Aug. 1992
Mark J. Mears, Stan Pruett, and John Houtz Aug. 1992 124 p
(AF Proj. 2403)
(AD-A259205; WL-TR-92-3101) Avail: CASI HC A06/MF A02

Self-Repairing Flight Control System (SRFCS) technology is an extension of traditional redundancy management. It uses existing redundancy in aircraft control surfaces to compensate for control surface failures and battle damage effects. The results of flight tests of a SRFCS, coded in Ada for an Unmanned Research Vehicle (URV) is described. This includes a description of the design of the control reconfiguration method, the Failure Detection (FDI) method, the Ada code, the URV model, data analysis of the flight test time histories, and the computational aspects of the algorithms. Time history plots of selected flight test results are included and acceptable performance was achieved for all the failure cases which were flown. GRA

N93-20596# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
FAILURE IDENTIFICATION USING MULTIPLE MODEL ADAPTIVE ESTIMATION FOR THE LAMBDA FLIGHT VEHICLE M.S. Thesis
Peter D. Hanlon 4 Dec. 1992 93 p
(AD-A259137; AFIT/GE/ENG/92D-19) Avail: CASI HC A05/MF A01

This study develops and investigates the performance of a Multiple Model Adaptive Estimator (MMAE) to detect and identify control surface and sensor failures on the LAMBDA flight vehicle (a URV developed by Wright Laboratories). The MMAE uses a bank of Kalman filters that predict the aircraft response to a given input, with each filter model based on a different failure hypothesis, and then forms the residual difference between the prediction and sensor measurements for each filter. The MMAE uses these residuals to determine the probabilities of the failures that are modeled by the Kalman filters. Initially the MMAE identified all these failures within 4 seconds of onset. Various performance improvement techniques were researched and the identification time was reduced to less than 2 seconds after failure onset. This improvement was mostly due to an increase in the penalty for measurement differences and through returning of the Kalman filters. The MMAE performance was tested at the boundaries of the LAMBDA flight envelope, with good performance found at points close to the design flight condition. The performance at points that were far from the design flight condition indicates that gain scheduling is required to provide adequate performance across the entire envelope. GRA

N93-20743# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.
A SIMULATOR STUDY INTO LOW SPEED LONGITUDINAL HANDLING QUALITIES OF ACT TRANSPORT AIRCRAFT Final Report
W. P. deBoer, J. A. J. vanEngelen, H. T. Huynh (Office National d'Etudes et de Recherches Aerospatiales, Paris, France.), O. P. Nicholas (Royal Aerospace Establishment, Farnborough, England.), and D. Schafranek (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen, Germany.) 1 Jul. 1990 175 p
(NLR-TP-89387-U; GARTEUR/TP-055; ETN-92-92856) Avail: CASI HC A08/MF A02

The acceptability to pilots of changes in transport aircraft handling qualities, due to failure from a sophisticated primary Flight Control System (FCS), to a simpler backup system with different but good characteristics, was assessed. The study was undertaken in a flight simulator. Work concentrated on longitudinal control on the landing approach, with particular emphasis on the change in handling qualities which might occur in reverting to backup control system. The results are presented, together with some general guidelines. Tentative measures are proposed, to predict the handling qualities of flight path control systems, and to predict the magnitude of the change in handling qualities in switching from one control system to another. ESA

N93-21057# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Hubschrauber und Flugzeuge.
EXPERIMENTAL RESULTS IN AERODYNAMIC STABILITY AND CONTROL OF A TSTO CONFIGURATION
Thomas Gottmann and Giancarlo Cucinelli Apr. 1992 18 p Presented at 70th AGARD Fluid Dynamics Panels Symposium on Theoretical and Experimental Methods in Hypersonic Flows, Turin, Italy, 4-8 May 1992
(MBB-FE-211-S-PUB-0482-A; ETN-93-93428) Copyright Avail: CASI HC A03/MF A01

A test campaign using the generic baseline configuration of a Two Stage To Orbit (TSTO) configuration was developed to give answers to the basic problems of stability control, within the wide range of angles of attack and Mach numbers, and the separation maneuver at a hypersonic Mach number. Aerodynamic stability and control over the entire Mach regime is focused upon, showing that some aerodynamic characteristics change significantly with increasing Mach number. Flap efficiency at high Mach numbers exhibits a strongly nonlinear behavior with an efficiency gain at positive angles of attack and positive flap deflection. Separation of the upper stage shows changes in longitudinal characteristics caused by interference effects in close proximities between upper and lower stage. ESA

N93-21197*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CONTROLLER PARTITIONING FOR INTEGRATED FLIGHT/PROPULSION CONTROL IMPLEMENTATION
Sanjay Garg Feb. 1993 28 p Presented at the American Control Conference, Chicago, IL, 24-26 Jun. 1992; sponsored by the AACC
(RTOP 505-62-50)
(NASA-TM-105804; E-7234; NAS 1.15:105804) Avail: CASI HC A03/MF A01

The notion of partitioning a centralized controller into a decentralized, hierarchical structure suitable for integrated flight/propulsion control (IFPC) implementation is discussed. A systematic procedure is developed for determining partitioned airframe and engine subsystem controllers (subcontrollers), with the desired interconnection structure, that approximate the closed-loop performance and robustness characteristics of a given centralized controller. The procedure is demonstrated by application to IFPC design for a Short Take-Off and Vertical Landing (STOVL) aircraft in the landing approach to hover transition flight phase. Author

N93-20427# National Space Development Agency, Ibaraki (Japan). Guidance and Control Lab.
RESEARCH ON HOPE FLIGHT CONTROL TECHNOLOGY [HOPE HIKOU SEIGYO GIJUTSU NO KENKYUU]
Hideto Suzuki, Hitoshi Mineno, Tatsushi Izumi, Mamoru Fukui, Nobuyoshi Hayashi, and Shuuichi Matsumoto *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 79-84 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A02/MF A03

N93-20628# National Research Council of Canada, Ottawa (Ontario). Inst. for Aerospace Research.
FLUID/STRUCTURES INTERACTIONS. AIRCRAFT CONSIDERATIONS
B. H. K. Lee *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 120-122 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N93-20255*# Texas A&M Univ., College Station. Aerospace Engineering Div.

FLIGHT VALIDATION OF A PULSED SMOKE FLOW VISUALIZATION SYSTEM Final Report

Donald T. Ward and Kenneth M. Dorsett Feb. 1993 44 p

(Grant NAG2-651)

(NASA-CR-192272; NAS 1.26:192272; TEES-AERO-TR-93-1) Avail: CASI HC A03/MF A01

A flow visualization scheme designed to measure vortex fluid dynamics on research aircraft was validated in flight. Strake vortex trajectories and axial core velocities were determined using pulsed smoke, high speed video images, and semi-automated image edge detection hardware and software. The smoke was pulsed by using a fast-acting three-way valve. The valve shuttle was redesigned by NASA engineers after it repeatedly jammed in flight. The new shuttle operated flawlessly during the last two tests in the series. A 25 percent scale gothic strake, similar in shape to the leading edge extension (LEX) on an F/A-18 aircraft, was used to generate vortex over the wing of a GA-7 Cougar. The strake was operated a local angle of attack of 22 deg and a Reynolds number of approximately 7.8 x 10(exp 5) per foot. The maximum axial velocities measured in the vortex core were between 1.75 and 1.95 times the freestream velocity. The experimental measurements were in good agreement with previously published data and predictions. Analysis of the pulsed smoke system's effect on forebody vortices indicates that the system may reorient the forebody vortex system, but that the blowing momentum coefficients normally used will have no appreciable effect on the LEX vortex system. It is recommended that a similar pulsed smoke system be installed on the F/A-18 High Angle Research Vehicle and that this approach be used to analyze vortex core dynamics during the remainder of its high angle of attack research flights. Author

N93-20312*# Hampton Univ., VA. Dept. of Engineering.

EVALUATION OF CANDIDATE WORKING FLUID FORMULATIONS FOR THE ELECTROTHERMAL - CHEMICAL WIND TUNNEL Status Report

Jale F. Akyurtlu and Ates Akyurtlu 31 Oct. 1991 18 p

(Grant NAG1-767)

(NASA-CR-192196; NAS 1.26:192196) Avail: CASI HC A03/MF A01

Various candidate chemical formulations are evaluated as a precursor for the working fluid to be used in the electrothermal hypersonic test facility which was under study at the NASA LaRC Hypersonic Propulsion Branch, and the formulations which would most closely satisfy the goals set for the test facility are identified. Out of the four tasks specified in the original proposal, the first two, literature survey and collection of kinetic data, are almost completed. The third task, work on a mathematical model of the ET wind tunnel operation, was started and concentrated on the expansion in the nozzle with finite rate kinetics. Author

N93-20555# Aeronautical Research Labs., Melbourne (Australia).

GUIDED WEAPONS DIVISION SPIN TABLE FACILITY: SPIN TABLE CONTROL SYSTEM

S. C. Garner, O. M. Williams, and D. A. Green Aug. 1992 22 p

(AD-A259214; ARK-GW-R-013; DODA-AR-007-108) Avail: CASI HC A03/MF A01

The control system developed and used successfully over the past two years for controlling the angular velocity of the Guided Weapons Division (GWD) spin table is described. The philosophy underlying the design is discussed, followed by description of the specific hardware and software components and the performance of the system as a whole. The report forms part of the permanent record of the GWD spin table facility development. GRA

N93-20576# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

A SYNTHETIC ENVIRONMENT FLIGHT SIMULATOR: THE AFIT VIRTUAL COCKPIT M.S. Thesis

John C. Switzer Dec. 1992 54 p

(AD-A259220; AFIT/GCS/ENG/92D-17) Avail: CASI HC A04/MF A01

This thesis describes the design and implementation of a part of the Virtual Cockpit: a synthetic environment, distributed network flight simulator. The goal of the project was to prove the concept that this type of flight simulator could fill the gap between high-end, very expensive flight simulators and low-end game quality flight simulators. The following topics are discussed: object-oriented design techniques, multi-processor utilization, the flight dynamics model, synthetic environment technology, the frame-rate vs. realism issue, and the interfaces to a realistic joystick and throttle. GRA

N93-21268# Dayton Univ. Research Inst., OH.

MEASUREMENT OF MODULATION TRANSFER FUNCTIONS OF SIMULATOR DISPLAYS Final Report, Oct. 1989 - Dec. 1990

George R. Kelly Dec. 1992 32 p

(Contract F33615-90-C-0005)

(AD-A259401; AL-TP-1992-0056) Avail: CASI HC A03/MF A01

The theory and methodology necessary for measuring the Modulation Transfer Function (MTF) of flight simulator displays is presented. The mathematical development of the MTF from linear system theory is outlined. The two primary methods for measuring MTF, namely the direct and indirect methods, are described and compared. The implementation of the indirect method is described in detail including measurement of the line spread function of a display, calculation of MTF from the line spread function, and calibration of the resulting MTF. The MTF's of various simulator display components and displays were measured with the indirect method and presented in graphical form. Some of the more interesting characteristics of each MTF are discussed. GRA

N93-21406# Cranfield Inst. of Tech., Bedford (England). Coll. of Aeronautics.

REVIEW OF INITIAL EXPERIMENTS USING THE HAWK MODEL, DYNAMIC RIG FACILITY, AND THE CED 1401 DIGITAL DATA ACQUISITION EQUIPMENT Quarterly Report No. 7

H. A. Hinds and M. V. Cook Jul. 1990 30 p Sponsored by RAE

(Cranfield-Aero-9017; ISBN-1-871564-41-7; ETN-93-93553) Avail: CASI HC A03/MF A01; Cranfield Inst. of Tech., Coll. of Aeronautics, Cranfield, Bedford MK43 0AL, England, HC

Work towards an ongoing program of research to evaluate the use of a Modified Stepwise Regression (MSR) procedure to predict aircraft stability and control derivatives is presented. The calibration of the control surface angles, the data acquisition system, and the measurement of moments of inertia are described. Testing of the MSR FORTRAN 77 program using data from the inertia experiments is discussed. The initial experimentation with the dynamic rig enabled the data acquisition system to be tested and improved. Various computer routines for the smoothing of data and the subsequent formatting of recorded data are in place. Geometrical definitions were sorted out and measured on the model and control surface angle calibrations were completed. The moments of inertia of the model were estimated, along with various aerodynamic damping derivatives. Objectives for the new quarter are given. ESA

N93-21467# National Inst. of Standards and Technology, Gaithersburg, MD.

NIST IMPACT TEST FACILITY

H. W. Shenton, E. D. Anderson, J. L. Gross, and R. D. Marshall Jan. 1992 27 p

(PB92-226315; NISTIR-4896) Avail: CASI HC A03/MF A01

The National Institute of Standards and Technology has recently constructed an Impact Test Facility (ITF), which is to be used in the investigation of the behavior of structural elements and systems subject to loads of short duration and high intensity. The ITF consists of a 21.9 m vertical drop tower and free-fall impactor. A peak impact velocity of 17 m/s can be attained in the ITF with a full-height drop, delivering 10,600 N-m of kinetic energy to a specimen using a 59 kg impact sled. The components of the system include the vertical drop tower, impact sled, sled hoist assembly, sled fall arresting system, specimen support frame, instrumentation, and data acquisition system. The system has been designed to be versatile and can be adapted to meet a wide variety of test requirements and is described. GRA

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N93-20044# Space Policy Advisory Board, Washington, DC.
THE FUTURE OF THE US SPACE INDUSTRIAL BASE
Nov. 1992 68 p
Avail: CASI HC A04/MF A01

Our space industrial base has given the United States the capability to be the world's leading space-faring nation. We have exploited space to greatly advance our national security by using extraordinarily sophisticated reconnaissance space systems to guard against military surprise, and other spacecraft that support the pinpoint delivery of weapons. We have fulfilled the dreams of those visionary national leaders who enacted the first National Aeronautics and Space Act by advancing our scientific knowledge of the planet we occupy and the universe around us. And the advancements in technology engendered by the U.S. space program have had world-wide impact in fostering entire new industries. The industrial base is broad. It is not merely plant and equipment, but an entire infrastructure of skilled scientific and technical manpower backed up by superb government, private and academic facilities and institutions. Author

N93-20410# National Space Development Agency, Ibaraki (Japan).
RESEARCH AND DEVELOPMENT ACTIVITIES OF THE TSUKUBASPACE CENTER Annual Report, Fiscal Year 1991 [HEISEI 3 NENDO TSUKUBA UCHUU SENTA KENKYUU KAIHATSU SEIKA GAIYOUSHUU]
Junichirou Shimizu, ed. and Takashi Hamasaki, ed. et al Aug. 1992 344 p In JAPANESE
(NASDA-TK-GC0066; JTN-93-80417) Avail: CASI HC A15/MF A03

The following topics were discussed: Japanese spacecraft, reentry vehicle, aerospace plane, space transportation systems, closed ecological system, satellite observation, remote sensors, optical sensors, space communication, optical communication, space manufacturing, low gravity manufacturing, spacecraft radiators, spacecraft navigation, spacecraft control, thermal resistance, spacecraft electronic parts, spacecraft batteries, durabilities, rendezvous and docking technology, robot arms, remote manipulator system, superconductors, spacecraft components, expandable structure, spacecraft antennas, data systems, data acquisition system, printed circuits, electric capacitors, electric filters, electric resistors, transistors, diodes, integrated circuits, solar cells, adhesives, and radiation tolerance. For individual titles, see N93-20411 through N93-20489.

N93-20411# National Space Development Agency, Ibaraki (Japan). Launch Vehicle and Satellite System Lab.
RESEARCH ON ADVANCED SPACECRAFT [SHOURAI NO UCHUUKI SHISUTEMU NO KENKYUU] **c18**
Tsutomu Iwata, Takao Etou, Ryouichi Imai, Kazuo Oota, Yutaka Kaneko, Toshihide Maeda, and Yutaka Takano *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 1-4 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

Engineering test satellite systems to validate element technologies required for spacecraft composing advanced space infrastructures are studied. Case studies are conducted on element technologies for diversified manned space technology and the outline of the engineering test satellite systems is demonstrated. Debris observing systems, their debris collection and retrieval methods which are being reviewed in many countries are examined. Technical problems are picked up, and the fundamental concept of experiment satellites is determined. Missions deemed to be suitable for micro-satellites and various civil on-ground technologies focusing on electronic technology applicable to them are picked up. Functions of extravehicular operation systems required by the missions, and fundamental concept of the systems and subsystems are made clear. Missions to which artificial gravity experiment satellites that are effective are examined and preparatory review is conducted on artificial gravity generation methods, methods to retrieve experiment equipment and samples, and outline of the satellite systems. Technical problems of engineering test satellites to validate on-orbit cryogenic propellant storage and transportation technologies are picked up and the fundamental concept of the satellites are determined. A review is conducted on electrical propulsion Orbit Transfer Vehicle (OTV) technology satellite to validate fundamental technology for large electrical propulsion engine and electrical propulsion engine OTV operation technology, and to pick up problems on the orbit of electrical propulsion OTV. Author (NASDA)

N93-20412# National Space Development Agency, Ibaraki (Japan). Launch Vehicle and Satellite System Lab.
RESEARCH ON LUNAR AND PLANET DEVELOPMENT AND UTILIZATION [TSUKI WAKUSEI NO KAIHATSU RIYOU NO KENKYUU]
Tsutomu Iwata, Takao Etou, Ryouichi Imai, Kazuo Oota, Yutaka Kaneko, Toshihide Maeda, and Yutaka Takano *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 5-8 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

Status of the study on unmanned and manned lunar missions, unmanned Mars missions, lunar resource development and utilization missions, remote sensing exploration missions, survey and review to elucidate the problems of research and development for lunar resource development and utilization, and the techniques and equipment for lunar and planet exploration are presented. Following items were studied respectively: (1) spacecraft systems for unmanned lunar missions, such as lunar observation satellites, lunar landing vehicles, lunar surface rovers, lunar surface hoppers, and lunar sample retrieval; (2) spacecraft systems for manned lunar missions, such as manned lunar bases, lunar surface operation robots, lunar surface experiment systems, manned lunar take-off and landing vehicles, and lunar freight transportation ships; (3) spacecraft systems for Mars missions, such as Mars satellites, Phobos and Deimos sample retrieval vehicles, Mars landing explorers, Mars rovers, Mars sample retrieval; (4) lunar resource development and utilization; and (5) remote sensing exploration technologies. Author (NASDA)

N93-20413# National Space Development Agency, Ibaraki (Japan). Launch Vehicle and Satellite System Lab.
STUDY ON ENVIRONMENT CONTROL AND LIFE SUPPORT TECHNOLOGY [KANKYOU SEIGYO/SEIMEI IJI GIJUTSU NO CHOUSA KENTOU] **c54**
Tsutomu Iwata and Yukata Takano *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 9-12 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

Study on Environmental Control and Life Support (ECLS) technology, common and fundamental technology for future manned spacecraft, is conducted to contribute planning research and development programs. Study is focused on a regenerative (air and water regeneration) Environmental Control and Life Support System (ECLSS), one of element technologies for manned platform taken as a reference model for this study. The reason for selecting regenerative ECLS is that the existing non regenerative ECLS is deemed to be disadvantageous in the aspects of transportation costs for logistics and waste, and resource consumption. Taking Manned Platform (MPF) as a reference model, subsystem technologies are studied focusing on following subjects: (1) air regeneration technologies, including carbon dioxide removal, carbon dioxide reduction and oxygen production, and toxic gas removal; and (2) water regeneration technologies. Author (NASDA)

N93-20414# National Space Development Agency, Miyagi (Japan).
RESEARCH ON ADVANCED TRANSPORTATION SYSTEMS [SHOURAIGATA YUSOUKEI NO KENKYUU] **c16**
Hirokazu Nagai, Ryouhei Hashimoto, Masataka Nosaka, Yukio Koyari, Yoshio Yamada (National Space Development Agency, Tokyo, Japan.), Keiichirou Noda (National Space Development Agency, Tokyo, Japan.), Suetsugu Shinohara (National Space Development Agency, Tokyo, Japan.), Tetsuichi Itou (National Space Development Agency, Ibaraki, Japan.), Takao Etou (National Space Development Agency, Ibaraki, Japan.), and Yutaka Kaneko (National Space Development Agency, Ibaraki, Japan.) *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 13-18 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A02/MF A03

An overview of the researches on advanced space transportation systems is presented. Conceptual study is conducted on fly back boosters with expendable upper stage rocket systems assuming a launch capacity of 30 tons and returning to the launch site by the boosters, and prospect of their feasibility is obtained. Reviews are conducted on subjects as follows:

(1) trial production of 10 tons sub scale engines for the purpose of acquiring hardware data and picking up technical problems for full scale 100 tons thrust engines using hydrocarbon fuels; (2) development techniques for advanced liquid propulsion systems from the aspects of development schedule, cost; (3) review of conventional technologies, and common use of component; (4) oxidant switching propulsion systems focusing on feasibility of Liquefied Air Cycle Engine (LACE) and Compressed Air Cycle Engine (CACE); (5) present status of slosh hydrogen manufacturing, storage, and handling; (6) construction of small high speed dynamometer for promoting research on mini pump development; (7) hybrid solid boosters under research all over the world as low-cost and clean propulsion systems; and (8) high performance solid propellant for upper stage and lower stage propulsion systems. Author (NASDA)

N93-20415# National Space Development Agency, Ibaraki (Japan). Total System Analysis Lab.

RESEARCH ON EARTH OBSERVING SATELLITE SYSTEM: CONCEPTUAL STUDY OF ADVANCED EARTH OBSERVING SATELLITE-2 (ADEOS-2) Report No. 1 [CHIKYUU KANSOKU EISEI SHISUTEMU NO KENKYUU: CHIKYUU KANSOKU GIJUTSU EISEI (ADEOS-2) GAINEN SEKKEI] **c18**

Yoshiaki Suzuki, Toshio Douura, Atsuo Tsuiki, and Tetsuya Kodama *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 19-24 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A02/MF A03

The conceptual study of the Advanced Earth Observing Satellite-2 (ADEOS-2) system, including units for mission data acquisition and transmission, was conducted in Fiscal Year 1991. The following three sensors are proposed as core sensors to be developed by NASDA: (1) Advanced Mechanically Scanned Radiometer (AMSR); (2) Global Imager (GLI); and (3) Advanced Visible and Near Infrared Radiometer (AVNIR). An overview of the satellite subsystem composition, concepts about mission data acquisition and transmission, and candidate core sensors were presented. Composite observation from non sun synchronous and geostationary orbits are necessary as well as sun synchronous orbits to understand the Earth as a system (earth system science.) The importance of continuing the development of earth observing satellite series, such as ADEOS, Tropical Rainfall Measuring Mission (TRMM), and Geostationary Meteorological Satellites (GMS's) are pointed out. Author (NASDA)

N93-20416# National Space Development Agency, Ibaraki (Japan). Specific Equipment Lab.

RESEARCH ON ADVANCED EARTH OBSERVING SENSORS [SHOURAIGATA CHIKYUU KANSOKU SENSA NO KENKYUU] **c19**

Takashi Noguchi, Yuuji Oosawa, Masakatsu Nakajima, Toshihiro Sezai, and Akira Furusawa *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 25-32 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A02/MF A03

The following activities were conducted: (1) component trial production and tests of Advanced Mechanically Scanned Radiometer (AMSR), including total system design and review, fundamental testing, and low noise bearing evaluation tests; (2) design study on Global Imager (GLI); and (3) design study on Light Detection and Ranging Radar (LIDAR). For the subject (1), a mechanical scanning system was selected because of its installability to the Advanced Earth Observing Satellite-2 (ADEOS-2) and superior absolute accuracy, and primary prospect to realize the system in a frequency range from 6.6 to 89.0 GHz was obtained. Total power system tests were conducted on characteristics change caused by the variation of the power source voltage and environment temperature, and prospect to get sufficiently better resolution than the Dicke system is obtained. Trial production and tests of low noise bearings were conducted to quantitatively evaluate torque noise, solid lubrication produces highest torque noises but it was not so high to cause satellite attitude disturbance. For the subject (2), design study on the global imager was conducted setting up specifications which incorporate extensive missions and spectrometer trial production and test were deemed necessary in selecting spectral dispersion system from the prosperous candidate systems, filter and diffraction gating, and cooling unit (expected service life 44,000 hours) size, and weight reduction can be more feasible by using mechanical (Stirling) system. For subject (3), design study on two types of LIDAR's, Mie LIDAR and Differential Absorption LIDAR (DIAL) was conducted. Author (NASDA)

N93-20417# National Space Development Agency, Ibaraki (Japan). Specific Equipment Lab.

IRCCD RESEARCH Report No. 6 and 7 [IRCCD NO KENKYUU] **c19**

Takashi Noguchi, Masakatsu Nakajima, and Akira Furusawa *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 33-38 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A02/MF A03

Research was made focused on confirming the principle of barrier height reduction of silicon Schottky Barrier Diode (SBD) by SiGe using palladium as an Schottky metal. SiGe layer growth temperature was reduced from 700 C to 500 C to improve its crystallinity, dopant was changed to B2O3 to keep P-type semiconductivity of the layer, and optimum doping conditions were determined. A trial production and test were conducted to determine the dependency of optical barrier height on mixed crystal ratio. Impurity mixing to Pt prior to and in Pt vaporization, which caused major problems in PtSi layer growing process, was reduced by improving Pt pre processing and modifying Molecular Beam Epitaxy (MBE) equipment. A better PtSi etching method was selected from several methods to replace the past inappropriate method. The dependency of the newly produced PtSi/SiGe SBD barrier height on crystal mixture ratio is evaluated. The possibility to detect 10 micrometer-band thermal infrared ray was first obtained. Author (NASDA)

N93-20418# National Space Development Agency, Ibaraki (Japan). Total System Analysis Lab.

RESEARCH ON DATA RELAY AND TRACKING SATELLITE SYSTEMS [DETA CHUUKEI TSUISEKI EISEI HISUTEMU NO KENKYUU] **c32**

Takao Anzai, Toshio Douura, and Satoshi Nagano *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 39-44 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A02/MF A03

An overview of the study on data relay and tracking satellite systems is presented. Study was made on the following subjects: (1) users' data transmission and operation requirements were rearranged and the number of onboard antenna for intersatellite communication and on orbit satellites; (2) function and performance budget for ground stations, data relay and tracking satellites, and users' spacecraft terminals; (3) data and operation interfaces between data relay and tracking satellites, and ground stations and systems; (4) load reduction of users' spacecraft and upgrading of data relay and tracking satellites; (5) circuit quality simulation for international mutual operation and satellite separation angles required between two data relay satellites; and (6) methods of high speed data distribution to overseas organizations. Author (NASDA)

N93-20419# National Space Development Agency, Ibaraki (Japan). Common Equipment Lab.

RESEARCH ON INTERSATELLITE LASER COMMUNICATION [EISEIKAN REZA TSUUSHIN NO KENKYUU] **c32**

Satoru Yamamoto, Hiroshi Arikawa, Shigeharu Nakamori, and Tomohiro Araki *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 45-48 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the research on intersatellite laser communication is presented. Components for acquisition and tracking system, and aberration compensating systems were trial produced. The range of trial production is shown in the diagram of research model, and the combination of the research model driving mechanisms are shown. Two kinds of main mirrors for the optical antenna used for optical communication equipment were trial produced. Trial production specifications for optical antenna is shown. Laser Diode (LD) output synthesizer made of optical fibers were trial produced and tested. Author (NASDA)

N93-20420# National Space Development Agency, Ibaraki (Japan). Common Equipment Lab.

RESEARCH ON SPACE COMMUNICATION EQUIPMENT TECHNOLOGY: STUDY ON RELAY SYSTEM [UCHUUYOU TSUUSHINKIKI GIKUTSU NO KENKYUU: CHUUKEIKI KEI] **c32**

In its Research and Development Activities of the Tsukuba Space Center

Aug. 1992 p 49-52 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

An overview of the research on space communication equipment technology, especially relay technology, are presented. Low Noise Amplifier (LNA) design review was conducted and the temporal tendency of the noise factors are shown. Design study on Solid State Power Amplifier (SSPA), characterized in small size, low weight, low deformation, and high reliability, was conducted and SSPA development tendency is shown. The results of the review on advanced communication systems are summarized. Author (NASDA)

N93-20421# National Space Development Agency, Ibaraki (Japan). Thermal and Structural Engineering Lab.
RESEARCH ON TWO PHASE FLUID LOOP TYPE HEAT REJECTION TECHNOLOGY [NISOU RYUUTAI RUPUSHIKI HAINETSU GIJUTSU NO KENKYUU] **c34**
Haruaki Itagaki, Takanobu Yamamoto, Tooru Iida, and Yasuo Ishii *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 53-56 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

The following activities were conducted using research type loop based on two phase fluid loop type heat rejection technology: (1) tests to determine parameters utilized for the control algorism; (2) trial production and automatic operation of a controller which can maintain the cold plate temperature to the specified temperature regardless of the thermal load variation; and (3) microgravity experiment to examine technical problems of two-phase fluid loops especially in microgravity and acquire technology related to validation test. The results of the activities are as follows: (1) void variation measurement (outer turbulence measurement test), when flow rate is kept constant and thermal load is changed, was conducted to determine PI (Proportional-Plus-Integral) control parameters, and thermal load variation test was conducted using adjusted control parameters to verify the controllability. Results such as control capability for large noises and dry-out prevention by setting up lower limit for flow rate adjustment were obtained; (2) a controller was trial produced to keep the temperature on the cold plates to the specified value and its capability to operate automatically according to the control program; and (3) 53 microgravity experiments were conducted in six flights and it was determined that fluid supply surplus was the most possible cause of flooding phenomenon generated in the grouped tube evaporator among causes, including liquid invasion from the vapor path and bubble generation in the liquid path.
Author (NASDA)

N93-20422# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.
RESEARCH ON SPACE COMPONENT AND MATERIAL MANUFACTURING EXPERIMENTS UTILIZING MICROGRAVITY ENVIRONMENT Report No. 1 [BISHOU JUURYOKU KANKYOU RIYOU NI YORU UCHUUYOU BUHIN ZAIRYOU SEIZOU JIKKEN NI KANSURU KENKYUU] **c29**
Tadaaki Kurosaki and Tatsurou Ono *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 57-60 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

Researches were conducted on manufacturing space components and materials with excellent properties, which can not be obtained on earth, utilizing microgravity in space on each of semiconductors and metallic materials. Surveys were conducted on production of candidate semiconductor materials for solar cells, semiconductor devices, and semiconductor lasers and candidate metallic materials such as particle dispersion strengthened alloys, eutectic alloys, and so forth for space components and materials with excellent properties, such as homogeneous and non-defective functions, and low-impurity ingredients, not obtainable on earth by utilizing microgravity and high vacuum in space, and possibility to produce components and materials of excellent performance was proven. Research subjects concerning manufacturing methods were shown. Manufacturing methods for the above candidate materials were examined and experiment plan up to manufacture was made for components and materials which were deemed to be most feasible to produce. Examples of manufacturing methods utilizing microgravity, high vacuum, vast space, and solar energy in space and experiment schedule utilizing dropping towers, Test Rocket-1A (TR-1A) space experiment rockets, and the Japanese Experiment Module (JEM) are shown. Author (NASDA)

N93-20423# National Space Development Agency, Ibaraki (Japan). Launch Vehicle and Satellite System Lab.
RESEARCH ON HOPE [HOPE NO KENKYUU] **c16**
Tetsuichi Itou, Jirou Kouchiyama, Yoshisada Takizawa, Hiroshi Aoki, Akihiro Eguchi, Yasuomi Kanou, Atsushi Murakami, Yasuji Hara, Hideo Bitou, and Yutaka Kaneko et al *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 61-64 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

An overview of the research on the 20 tons H-2 Orbiting Plane (HOPE) is presented focusing on technical problems which greatly influences to the body weight. The purpose and missions of HOPE program, fundamental conditions, flight profile, approximate configuration and major dimensions, major performances, and concept of development are described.
Author (NASDA)

N93-20424# National Space Development Agency, Ibaraki (Japan). Total System Analysis Lab.
CONCEPT OF OVERALL OPERATION OF H-2 ORBITING PLANE (HOPE) [HOPE ZENTAI UNYOU KOUSOU] **c16**
Yoshiaki Suzuki, Kenji Nishiyama, Shuuji Ono, and Junichi Moriuma *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 65-68 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

An overview of the research on overall concept of operation of H-2 Orbiting Plane (HOPE) is presented. Factors required for overall HOPE operation were deemed to be flight, safety to protect human life, flight control and flight safety at a speed of Mach 25, flight control and re-entry for from deorbiting to the re-entry point, landing guidance after re-entry to atmosphere, and flight operation system more reliable than HOPE are explained. A series of maneuver such as separation from orbit, re-entry to the atmosphere, flight control maneuver for landing, and returning to and landing on the landing site are also described. Author (NASDA)

N93-20425# National Space Development Agency, Ibaraki (Japan). Total System Analysis Lab.
HOPE INFORMATION SYSTEM REVIEW [HOPE JOUHOU SHISUTEMU NO KENTOU] **c18**
Yoshiaki Suzuki, Kenji Nishiyama, Shuuji Ono, and Kouin Fukuda *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 69-72 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

An overview of the review conducted on H-2 Orbiting Plane (HOPE) is presented. A prototype model was constructed by inputting various technical information proposed by related laboratories. Especially operation flow which enables understanding of correlation between various analysis items, judgement criteria, technical data, and interfaces with others was constructed. Technical information data base and retrieval systems were studied. A Macintosh personal computer was selected for information shaping because of its excellent function, performance, operability, and software completeness. Author (NASDA)

N93-20426# National Space Development Agency, Ibaraki (Japan). Thermal and Structural Engineering Lab.
RESEARCH ON HEAT-RESISTANCE TECHNOLOGY FOR HOPE [HOPE YOU TAINETSU KOUZOU GIJUTSU NO KENKYUU] **c18**
Yoshiki Morino, Mamoru Ishikawa, Toshinari Yoshinaka, Hirobumi Tamura, and Youichi Satou *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 73-78 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A02/MF A03

An overview of the research on heat-resisting structure technology is presented. Fundamental data acquisition and forming test were conducted with carbon-polyimide composite material as the first candidate material to reduce main structure weight. Fundamental testing was conducted on characteristics of material and structural elements, and anti oxidization

coating for carbon-carbon composite materials required for ultra high temperature section such as front edge of the wing. Element trial-production and fundamental testing concerning the design and feasibility of the concept were conducted on carbon-carbon Thermal Protection Substance (TPS), one of the candidate TPSs. Arc heating wind tunnel and radiation heating equipment were studied for super high temperature heating equipment.
Author (NASDA)

N93-20427# National Space Development Agency, Ibaraki (Japan). Guidance and Control Lab.
RESEARCH ON HOPE FLIGHT CONTROL TECHNOLOGY [HOPE HIKOU SEIGYO GIJUTSU NO KENKYUU] **c08**
Hideto Suzuki, Hitoshi Mineno, Tatsushi Izumi, Mamoru Fukui, Nobuyoshi Hayashi, and Shuuichi Matsumoto *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 79-84 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A02/MF A03

An overview of the research on flight control technology for H-2 Orbiting Plane (HOPE) are presented. Trial production and test were conducted on the guidance control computer functional model to be used later for flight control system testing, focusing on realizing high speed computing unit with 32 bit Micro Processor Unit (MPU), mating evaluation of trial produced components, structure to facilitate subjecting them to various tests, including flight control test, and reduction of weight, power consumption, and size. Analysis using the research Function Simulation Program (FSP) used for simulating the Guidance Control Program (GCP), verification of GCP computation logic, and validate mission constants and preliminary design of the research GCP were conducted. Research was conducted on onboard software validation system, which consists of design analysis system, and onboard software production and validation systems. Dynamic wind tunnel test of HOPE was conducted in cooperation with the National Aerospace Laboratory (NAL) for the purpose of acquiring data concerning stability, controllability, and control principle design. Fundamental review of onboard computer and definition study of landing simulation were conducted.
Author (NASDA)

N93-20428# National Space Development Agency, Ibaraki (Japan). Guidance and Control Lab.
RESEARCH ON COMBINED HOPE NAVIGATION TECHNOLOGY [HOPE FUKUGOU KOUHOU GIJUTSU NO KENKYUU] **c18**
Hideto Suzuki, Hitoshi Mineno, Shigehiro Mori, Isao Kawano, Shuuichi Matsumoto, and Shingo Hirata *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 85-88 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

An overview of the research on navigation sensors of HOPE (H-2 Orbiting Plane) required for landing and on-orbit phases is presented. Microwave Landing System (MLS) which is a system to measure required azimuth and elevation from the runway for landing and an element for combined navigation with inertial sensor and RF (Radio Frequency) altimeter, were trial produced and tested. Trial production and test of the research model Global Positioning System (GPS) which receives RF wave from 24 (scheduled) satellites deployed in space were completed. Preparatory operation tests were conducted with the functional model of the fixed star sensor to measure spacecraft attitude in reference to space.
Author (NASDA)

N93-20429# National Space Development Agency, Ibaraki (Japan). Common Equipment Lab.
RESEARCH ON HOPE COMMUNICATION AND DATA PROCESSING EQUIPMENT [HOPE TSUUSHIN DETA SHORI KIKI NO KENKYUU] **c32**
Satoru Yamamoto and Toshio Kikuchi *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 89-92 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

An overview of the research on heat-resisting antenna is presented. Candidate heat-resisting antennas which were selected as the result of review on seven kinds of antenna are the antennas of micro strip, cavity, and horn types. Heat resistance characteristics of electric power supplying section (connectors) of heat-resisting antenna were studied. Heat cycling test and heat shock tests were conducted on the subject plugs and it was confirmed that they can be usable at - 80 C to + 200 C against - 65 C to + 125 C for the existing plugs. Fundamental electric data such as antenna pattern were acquired mating trial produced components simulating electric characteristics of heat-resisting antenna and trial-produced ceramic tiles.
Author (NASDA)

N93-20430# National Space Development Agency, Ibaraki (Japan). Thermal and Structural Engineering Lab.
RESEARCH ON HOPE ACTUATOR POWER UNIT [HOPE DOURYOKU SOUCHI NO KRNKYUU] **c37**
Haruaki Itagaki, Tooru Iida, and Yasuo Ishii *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 93-96 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

An Overview of the review conducted on Actuator Power Unit (APU) of HOPE (H-2 Orbiting Plane) based on a base line constructed combining conventional technologies are presented. Partial trial production and test on lubrication subsystems to acquire fundamental data on lubricant supply and retrieval system which is not affected by microgravity and gravity directions were conducted. The subject subsystem was constructed to facilitate visual observation from the side of gas and liquid separating conditions. The results of test conducted changing parameters such as void ratio, the ratio of lubricant to residual space (GN2 gas) in the gear box are shown. A lubrication system flow chart is shown.
Author (NASDA)

N93-20431# National Space Development Agency, Ibaraki (Japan). Thermal and Structural Engineering Lab.
RESEARCH ON HOPE HEAT SINK DEVICE [HOPE NETSU SHINKU SOUCHI NO KENKYUU] **c34**
Haruaki Itagaki, Takanobu Yamamoto, Tooru Iida, and Yasuo Ishii *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 97-102 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A02/MF A03

An overview of the research on H-2 Orbiting Plane (HOPE) Heat Sink Device (HSD) is presented. A spray nozzle was trial produced and tested to improve spray distribution, and data for assessing spray distribution under presumed heating surface temperature distribution were obtained. Fundamental tests on evaporation and cooling (cooled fluid was freon) were conducted simulating dome flushing evaporation system for high vacuum HSD with the spray nozzle and the dome configuration were conducted to assess its cooling characteristics and frosting phenomena. Sprayed water flow rate via spray cooling efficiency and sprayed water flow rate via freon inlet temperature at the frosting limit relationships were obtained. HSD systems for low-altitude use and oil cooling were traded off.
Author (NASDA)

N93-20432# National Space Development Agency, Ibaraki (Japan). Launch Vehicle and Satellite System Lab.
ORBIT RE-ENTRY EXPERIMENT VEHICLE DEVELOPMENT [KIDOU SAITOTSUNYUU JIKKENKI NO KAIHATSU] **c18**
Masataka Yamamoto, Kouji Yamawaki, Toshio Akimoto, Atsushi Murakami, Motoyuki Inaba, Yutaka Kaneko, Takayuki Shimoda, Yasuo Ishii, Tatsushi Izumi, and Isao Kawano et al *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 103-110 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A02/MF A03

An overview of the Orbital Re-entry Experiment (OREX) vehicle development, including detail design, analyses on the overall system, guidance and control, propulsion, and data acquisition systems is presented. The outline of the experiment vehicle is shown. OREX flight is analyzed and the splash down point variance ellipse is shown. Vehicle body aerodynamic characteristics were analyzed and validated by supersonic wind tunnel and dynamically balanced wind tunnel tests. Analyses on onboard equipment environmental resistance, controllability from on orbit to re-entry phases and navigation and guidance of the space plane were conducted. It was confirmed that there was no problem on the guidance and control system. Review on the propellant volume and analyses on the propulsion system performance, propulsion system heat exchanger performance, and thruster and piping system temperature were conducted and possibility of hard starting of the 150 N hydrazine thruster was noticed. RF (Radio Frequency) link analyses were conducted around Tanegashima, Ogasawara,

and the splash down area and prospect of continuously acquiring good link margin for 300 seconds was obtained. Semi unitized structure of truncated cone shape with main body made of aluminum alloy, which has application record for rockets, laid with skin, stringers, and frames was employed for the structure. Data acquisition systems for tracking and operation, including those at Tanegashima, Ogasawara, Christmas, down range ship, and airplane tracking stations were studied. Author (NASDA)

N93-20433# National Space Development Agency, Ibaraki (Japan). Thermal and Structural Engineering Lab.

DEVELOPMENT AND TESTS ON OREX VEHICLE THERMAL STRUCTURE SYSTEM [KIDOU SAITOTSUNYUU JIKKENKI NETSU KOUZOUKEI KAIHATSU SHIKEN OYOBI SONO SEIKA] **c18**

Toshinari Yoshinaka and Yoshiki Morino *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 111-116 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A02/MF A03

An overview of the thermal system structure development and their tests for Orbital Re-entry Experiment (OREX) vehicle, being developed as a part of H-2 Orbiting Plane (HOPE) development, is presented. The results of study on the OREX vehicle thermal structure system and concept of the system study are shown. The results of HOPE thermal structure system research were reflected to OREX in employing polyacrylonitrile tissues with conversion coating for the nose cap, Carbon-Thermal Protection System (TPS), and ceramic tile TPS for the structure. Test plans were established for material characteristics and design verifications, and flight validation for C/C (Carbon/Carbon Composite) nose cap and TPS, and gap filler, arc wind tunnel, heat insulation, and adhesion quality verification tests. Environment resistance of the C/C nose cone, C/C TPS, and ceramic tile TPS were verified and prospects of their manufacturing were obtained.

Author (NASDA)

N93-20434# National Space Development Agency, Ibaraki (Japan). Common Equipment Lab.

RESEARCH AND DEVELOPMENT OF K-BAND INTERSATELLITE COMMUNICATION EXPERIMENT EQUIPMENT ONBOARD ETS-6 [ETS-6 TOUSAI K BANDO EISEIKAN TSUUSHIN JIKKEN KIKI NO KENKYUU KAIHATSU] **c32**

Satoru Yamamoto, Noboru Takata, and Ryuuji Temino *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 117-120 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the integration and acceptance test of the K band Single Access (KSA) system for the Engineering Test Satellite-6 (ETS-6) and the acceptance test of the K band Feeder Link Communications Equipment (FLCE) for ETS-6 as a subsystem is presented. The KSA system underwent acceptance test following the integration of the KSA relay and the O band Communications Equipment (OCE) to the KSA antenna (including the electronic equipment installation platform, antenna pointing control components, and so forth). The test was completed satisfying all requirements after the discrepancies occurred in the structure system during sinusoidal wave vibration test were corrected. The acceptance test of the FLCE included initial electric performance, temperature, electromagnetic compatibility, final electric performance, and mechanical inspection tests, and their results are summarized. Author (NASDA)

N93-20435# National Space Development Agency, Ibaraki (Japan). Common Equipment Lab.

DEVELOPMENT OF SATELLITE BORNE NICKEL HYDROGEN BATTERY EXPERIMENT EQUIPMENT FOR ETS-6 [ETS-6 YOU NIKKERU SUISO BATTERI TOUSAI JIKKEN KIKI NO KAIHATSU] **c33**

Saburou Kuwashima, Norimitsu Kamimori, Hiroaki Kusawake, and Kazumichi Takahashi *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 121-124 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the support rendered for the Engineering Test Satellite-6 (ETS-6) system integration test and protoflight test by the ETS-6 borne experimental nickel hydrogen battery development part is presented. Articles in the ETS-6 specifications and procedures related to the experimental battery were prepared or supported in preparation because of the battery's special characteristics such as its automatic control dependency on the bus voltage, thermal sensitivity equivalent to that of other batteries and so forth. System tests were witnessed and the acquired data were evaluated. Charging characteristics from 0 V were verified at trickle charging rate, using a flight scale model of Nickel Hydrogen (Ni-H2) Battery (NHB) after long term storage and an engineering model of the Ni-H2 Battery Controller (NHC). Requests for approval were submitted to the related self governing bodies in accordance with the Explosives Control Law when NHB's were charged and discharged. Installation and calibration data acquisition of the inner pressure sensors for the Ni-H2 battery cells for the flight model NHB were conducted and the battery assembly was started. Author (NASDA)

N93-20436# National Space Development Agency, Ibaraki (Japan). Guidance and Control Lab.

RESEARCH ON EQUIPMENT LIFE EXTENSION TECHNOLOGY [KIKI NO CHOUJUMYOUKA GIJUTSU NO KENKYUU] **c19**

Shigehiro Mori and Shingo Hirata *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 125-128 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the long duration life tests conducted on Tuned Dry Gyros (TDG's), major components for Inertial Reference Unit (IRU), and small, light, and long life Reaction Wheels (RW's), and Momentum Wheels (MW's) used for geostationary three axis stabilized satellites is presented. Total 13 TDG's, including three of each produced in the second and third trial productions and seven of life test TDG's, underwent the following tests and each test subject operated satisfactorily: (1) service life tests on 11 TDG's; (2) drift temperature coefficient measuring tests on three of life test TDG's; and (3) shelf life tests on two TDG's. Three life test of Small Reaction Wheels (SRW's) and three of Engineering Test Satellite-6 (ETS-6) RW Engineering Models (EM's) underwent the following tests and data satisfying the specified values were acquired: (1) life test on three SRW's to assess their constant revolution, shock pulse, coasting down, and run up characteristics; and (2) life tests on three ETS-6 RW EM's to evaluate their reliability and service lives by long duration operations in two patterns. Two life test of MW's underwent the following life tests and they showed very stable characteristics: (1) stationary characteristics measurement; (2) coasting down time measurement; and (3) run-up time measurement.

Author (NASDA)

N93-20437# National Space Development Agency, Ibaraki (Japan). Total System Analysis Lab.

CONCEPTUAL STUDY OF ETS-7 Report No. 2 [ETS-7 NO GAINEN SEKKEI] **c18**

Takao Anzai, Mitsushige Oda, Yasufumi Wakabayashi, and Ryouichi Imai *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 129-132 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the Engineering Test Satellite-7 (ETS-7) conceptual study is presented. The Rendezvous and Docking (RVD) experiments will be conducted to verify equipment technologies for navigation, guidance, control algorism, and sensors and to conduct remote control technology experiment using on-orbit image information during the time period from the RVD experiment target separation to its berthing back to the satellite by Global Positioning System (GPS) correlated navigation, and approach by the rendezvous radar and proximity sensors. The space Robot (RBT) experiments will be conducted on the coordinated experiment between the robotic arm control and satellite body attitude control systems, remote control experiment from the earth using on orbit image information with time delay, and on-orbit operation technology using the task board and simulated Orbital Replacement Unit (ORU). An operation system to utilize the intersatellite data relay function of the Communications and Broadcasting Engineering Test Satellite (COMETS) will be employed. Review was conducted on satellites to satisfy RVD requirements and enable piggy back launch with the Tropical Rainfall Measuring Mission (TRMM). The satellite bus system will be constructed by fundamentally utilizing the technologies applied to the Engineering Test Satellite-6 (ETS-6) and the Advanced Earth Observing Satellite (ADEOS). Prospects of realizing operation systems, including experimental window and remote control operation by images were obtained. Author (NASDA)

N93-20438# National Space Development Agency, Ibaraki (Japan). Guidance and Control Lab.

RESEARCH ON RENDEZVOUS AND DOCKING TECHNOLOGY [RANDEBU DOKKINGU GIJUTSU NO KENKYUU] **c18**

Shinichirou Ichikawa, Isao Kawano, Hiroyuki Suzuki, and Mitsuru Yamada *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 133-136 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

The following reviews were conducted on rendezvous and docking technology: (1) second design and review on the Rendezvous and Docking (RVD) technology for the Engineering Test Satellite-7 (ETS-7), such as RVD on orbit experiments, RVD experiment system; (2) second RVD system test research, such as integration test of the onboard software, RVD operation support function software, detail review on system research tests, and RVD system research equipment production; (3) first research on the rendezvous and Global Positioning System (GPS) correlated navigation, such as system design and ground test method review; (4) research on high accuracy GPS receiver, such as high accuracy receiving technology and design review on high accuracy receiver system; (5) trial production and test of the critical components for GPS receiver, including design review on trial production and test of the critical components for and trial production and test of the proximity sensors; and (6) trial production and test of the proximity sensors, including the system design, trial production and test of components and system evaluation models. Author (NASDA)

N93-20439# National Space Development Agency, Ibaraki (Japan). Thermal and Structural Engineering Lab.

RESEARCH ON DOCKING MECHANISM SYSTEM TEST Report No. 2 [DOKKINGU KIKOU SHISUTEMU SHIKEN NO KENKYUU] **c18**

Yoshiki Morino, Haruaki Itagaki, and Shigeto Shibuta *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 137-140 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the research on docking mechanism system test is presented. Reviews were conducted focusing on the effects of physical parameters, such as friction between sliding sections, clearance at linking sections, and spring coefficients of springs, and appropriate parameter values were determined. Element technology review was conducted focusing on the behavior of the sliding, linking, and driving sections. Review was also conducted on the function, characteristics, and the scope of application of the mechanism analysis software. Ground deployment test technology was studied, and surveys on advanced structure materials was conducted. Author (NASDA)

N93-20440# National Space Development Agency, Ibaraki (Japan). Launch Vehicle and Satellite System Lab.

RESEARCH ON SPACE ROBOT TECHNOLOGY [UCHUUYOU ROBOTTO GIJUTSU NO KENKYUU] **c37**

Tsutomu Iwata, Yasufumi Wakabayashi, and Mitsushige Oda *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 141-144 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the research on space robot technology is presented. Evaluation tests were conducted concerning visual recognition, remote control, and highly functional manipulation technologies. Knowledge assessed by the above evaluation tests were: (1) the projections of the amount of image information for remote control; (2) verification of the effectiveness of prediction simulation for remote sensing with time delay; (3) knowledge about the characteristics, and layout of the visual equipment required for remote control; (4) knowledge about functions required for onboard control system to cope with imperfect remote control; and (5) primary knowledge about conducting complex control calculation for robotic arms with onboard computer of limited capability. Author (NASDA)

N93-20441# National Space Development Agency, Ibaraki (Japan). Total System Analysis Lab.

RESEARCH ON SPACE SUPERCONDUCTING ELEMENT TECHNOLOGY [UCHUUYOU CHOUDENDOU YOUSO GIJUTSU NO KENKYUU] **c33**

Toshio Douura, Atsuo Tsuiki, and Satoshi Nagano *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 145-148 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the research on space superconducting element technology is presented. Receiver with Superconductor Insulator Superconductor (SIS) mixers for observing the earth was studied on characteristics of those of single end balanced types, SIS mixer behavior, and characteristics of acoustooptic and correlated digital spectrometer required for the later stage of the SIS receiver. Review on superconducting high frequency elements was conducted on applications for mobile communication and data relay satellites, and intersatellite communication. Research on superconducting magnetic bearings was conducted and it was confirmed that their size might be considerably larger than that of ball bearing but the technology can be used for micro machines. A survey was conducted on space experiments of domestic and overseas superconducting materials using small rockets, airplanes, and dropping towers, and the up to date status of the Particle Astrophysic Magnet Facility (ASTROMAG) project to detect elementary particles by a large superconducting magnet installed onboard the space station Freedom. Author (NASDA)

N93-20442# National Space Development Agency, Ibaraki (Japan). Thermal and Structural Engineering Lab.

RESEARCH ON SPACE COOLERS [UCHUUYOU REIKYAKUKI NO KENKYUU] **c31**

Haruaki Itagaki, Takanobu Yamamoto, Tooru Iida, Yasuo Ishii, and Keiichi Okuyama *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 149-154 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A02/MF A03

An overview of the research on coolers for space use is presented. Testing jigs for the research model trial produced and assembled in Fiscal Year 1991 were assembled and adjusted. Concept of cooler development based on the assumption to be installed onboard the Japanese Experiment Module (JEM) to enable super cryogenic cooling to 20 K were studied and its schematic drawing was shown. Review on coolers which satisfy the specification for the cooler for the Global Imager (GLI) installed onboard the Advanced Earth Observing Satellite-2 (ADEOS-2) was conducted and prospect to attain the cooling performance was obtained, and the schematic drawing of its structure was shown. Review on the life test methods was conducted and it was determined to employ leak, gas analysis, and continuous endurance tests for life testing. Author (NASDA)

N93-20443# National Space Development Agency, Ibaraki (Japan). Thermal and Structural Engineering Lab.

RESEARCH ON SPACE STRUCTURE MATERIALS [UCHUUYOU KOUZOU ZAIRYOU NO KENKYUU] **c18**

Kouzou Yudate, Shigeto Shibuta, and Yoshiki Morino *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 155-158 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the research conducted on space structure materials is presented. Major characteristics required for materials used for spacecraft structures operated in space for a long time were studied in the following aspects: (1) large specific strength and specific elasticity; (2) excellent characteristics stability; (3) excellent size stability; (4) large damping factor; and (5) excellent space environment resistance. Plastic-Metal Composite (PMC) and Metal-Metal Composite (MMC), most prosperous materials for space structures, were studied. Additionally hardened polyimide to withstand 300 C was under development as the main structural material for the H-2 Orbiting Plane (HOPE), and thermoplastic resin and liquid crystal composite were studied. MMC was deemed to be more prosperous material than PMC because of the superiority in physical properties. Joint research on radiation resistance of space structure materials was being conducted in cooperation with Takasaki Establishment of the Japan Atomic Energy Research Institute. Author (NASDA)

N93-20444# National Space Development Agency, Ibaraki (Japan). Thermal and Structural Engineering Lab.
RESEARCH ON LARGE STRUCTURE ASSEMBLY TECHNOLOGY: RESEARCH ON DEPLOYABLE ASSEMBLY STRUCTURE Report No. 3 [OOGATA KOUZOUBUTSU KUMITATE GIJUTSU NO KENKYUU: TENKAI KUMITATE KOUZOU NO KENKYUU] **c18**
Yoshiki Morino and Shigeto Shibuta *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 159-162 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

An overview of the simulation analyses of element mechanisms for deployable assembly structures is presented. System mechanism analyses were conducted using a mathematical model constructed for one unit cell of the deployable trusses. Element mechanism analyses were conducted using mathematical models constructed for each of the critical elements of deployable trusses, such as telescopically deployable section, joint section, deployment and folding driving mechanism, and so forth. Review on the function, characteristics, and the scope of mechanism analysis software to study on ground and on orbit deployment technologies were conducted. Preliminary review was conducted on test equipment and techniques to effectively facilitate the deployment function verification. Conceptual design of the docking mechanism for the Engineering Test Satellite-7 (ETS-7) to acquire the Rendezvous and Docking (RVD) and robotic technologies was conducted. Some examples of the simulation are shown. Author (NASDA)

N93-20445# National Space Development Agency, Ibaraki (Japan). Guidance and Control Lab.
RESEARCH ON HIGHLY FUNCTIONAL GUIDANCE AND CONTROL TECHNOLOGY [KOUKINOU YUUSOU SEIGYO GIJUTSU NO KENKYUU] **c17**
Shigehiro Mori, Hitoshi Mineno, Isao Kawano, Mamoru Fukui, Mitsuru Yamada, and Shingo Hirata *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 163-164 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

An overview of the research on highly functional guidance and control system and equipment technologies is presented. Survey and review on fuzzy technology were conducted in the following aspects: (1) evaluation of fuzzy technology applicability to space technology problems; and (2) review on problems and their remedies in fuzzy technology application in space. Research on the following aspects of extensive redundancy control technology was conducted: (1) environment and reliability for redundancy control; (2) detail and examples of application of the conventional redundancy control technologies to the real systems; and (3) future direction of redundancy control review. Fixed point observation was conducted at the known point on the ground using two Global Positioning Systems (GPS's) and fundamental data were acquired on correlation between the GPS satellite layout and azimuth and elevation errors, effects of selectivity and applicability, and differential navigation accuracy. Design, production, and test were conducted on the second trial produced fiber gyros, mostly accomplishing the target performance, and approximate specifications for fiber gyro Inertial Measuring Unit (IMU) and Inertial Reference Unit (IRU) were established. Author (NASDA)

N93-20446# National Space Development Agency, Ibaraki (Japan). Specific Equipment Lab.
RESEARCH ON PHASED ARRAY ANTENNA [FEZUDARE ANTENA NO KENKYUU] **c32**
Toneo Kawanishi and Yasuo Tamai *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 165-168 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

An overview of the research on the applicable missions and element technologies of Active Phased Array Antenna (APAA) is presented. Applicable areas of APAA were studied and shown. Comparison of APAA with an existing antenna system was conducted in performances and phase errors, taking inter satellite communication antenna (aperture diameter 10 m) as an example. Element technologies for major structural elements were studied and elements which necessitate development most were determined to be beam control, RF (Radio Frequency) (Module), and failure diagnosis sections. Author (NASDA)

N93-20447# National Space Development Agency, Ibaraki (Japan). Specific Equipment Lab.
RESEARCH ON BEAM COMPRESSION TECHNOLOGY [BIMU ASSHUKU GIJUTSU NO KENKYUU] **c32**
Toshihiro Sezai and Yuuji Oosawa *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 169-172 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

An overview on the verification of the fundamental principles of beam compression technology is presented. The principle of multiplication type beam compression are outlined. Beam compression was verified by receiving RF (Radio Frequency) waves rotating an antenna system around the main antenna axis in two test configurations with different distance between main and reference antennas. Author (NASDA)

N93-20448# National Space Development Agency, Ibaraki (Japan). Common Equipment Lab.
RESEARCH ON DATA HANDLING TECHNOLOGY [DETA HANDORINGU GIJUTSU NO KENKYUU] **c32**
Satoru Yamamoto, Hiroshi Anegawa, and Masahiro Kasuya *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 173-176 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

An overview of the reviews on advanced data handling systems is presented. Advanced onboard data handling systems with packet type data interface are studied and their conceptual drawing are shown. Advanced onboard data handling systems suitable for tele operation missions were studied and several methods to overcome their difficulty are suggested. Review on autonomic management and control technology was conducted, and hierarchical structure of autonomic management and control functions was defined and concept of the functions was established. Data transmission systems and onboard computers were studied especially in case optical data bus system was applied. Author (NASDA)

N93-20449# National Space Development Agency, Ibaraki (Japan). Common Equipment Lab.
RESEARCH ON SATELLITE-BORNE HIGH SPEED DATA RECORDER [TOUSAIGATA KOUSOKU DETA REKODA NO KENKYUU] **c35**
Satoru Yamamoto, Hiroshi Anegawa, and Masahiro Kasuya *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 177-182 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A02/MF A03

Design review focused on optical disc system was conducted to pick up future development problems and fundamental evaluation test (radiation irradiation test) on its critical components, optical disc media and optical elements (laser diode and photodiode), were conducted. The results of the design and review were presented as follows: (1) a draft of target specifications of the optical disc data recorder, interchangeable with magnetic Mission Data Recorder (MDR), to be first installed onboard the Advanced Earth Observing Satellite-2 (ADEOS-2) was determined; (2) Japan's ground use optical disc technology was deemed to possess sufficient technical foundation for developing satellite borne optical disc data recorders; (3) measures to accomplish high speed and large capacity, such as disc scale up, and employing multidisc system, high numerical aperture head, and Non Return to Zero (NRZ) system were studied; (4) it was deemed necessary to reduce power consumption by evacuation or decompression as discs size and revolving speed increase; and (5) applying the measures described in the above (3) and (4), a system structure plan suitable for the target specifications could be determined. The fundamental evaluation test demonstrated that there was no notable deterioration on laser diodes or photodiodes, no functional problem on photomagnetic disc media, or no effects on recording magnetic substrate. Author (NASDA)

N93-20450# National Space Development Agency, Ibaraki (Japan). Common Equipment Lab.
SPACE ENVIRONMENT MODEL CONSTRUCTION TECHNOLOGY [UCHUU KANKYOU MODERU NO SEIBI GIJUTSU] **c18**
Hironobu Nishimoto and Haruhisa Matsumoto *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992

p 183-186 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

A space environment model was constructed based on the results of the review on space environment model conducted in Fiscal Year 1986 and 1987. The space environment model was constructed to collect theories and data required for grasping various physical entities such as radiation, plasma, and spacecraft fragments and so forth, and to enable quantitative prediction of their time wise, spacial distribution and their effects such as electrification and material deterioration, and its system structure and functions were shown. The Technical Data Acquisition Equipment (TEDA) installed onboard the Engineering Test Satellite-5 (ETS-5) consist of various satellite environment monitors and component and material deterioration monitors for the purpose of acquiring technical data required for design and evaluation for satellite development. Review was conducted to clarify the correlation between each TEDA data and to apply the result in constructing the satellite environment model. Correlation between each TEDA data was made clear. Author (NASDA)

N93-20451# National Space Development Agency, Ibaraki (Japan). Common Equipment Lab.

MANUFACTURE OF ADEOS BORNE TECHNICAL DATA ACQUISITION EQUIPMENT Report No. 1 [ADEOS TOUSAIYOU GIJUTSU DETA SHUTOKU SOUCHI NO SEISAKU] **c35**

Hironobu Nishimoto and Haruhisa Matsumoto *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 187-190 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

An overview of the detail design for manufacturing the Technical Data Acquisition Equipment (TEDA) of the Advanced Earth Observing Satellite (ADEOS) are presented. The TEDA functional block diagram was determined after incorporating the following changes based on the reviews and trade off: (1) numbers of Contamination Monitor (COM) and Potential Monitor (POM) was reduced to each one; (2) a Heavy Ion Telescope (HIT) visibility angle of 40 deg. was determined; and (3) the location of COM installation was decided on the Z surface. Specifications for monitors, including radiation Dose Meter (DOM), Single Event Up set Monitor (SUM), POD, COM, and HIT, were determined on the function, detectors, subjected of measurement, storage and operation temperature ranges. Author (NASDA)

N93-20452# National Space Development Agency, Ibaraki (Japan). Environmental and Structural Test Dept.

RESEARCH ON ADVANCED SPACECRAFT TESTING TECHNOLOGY [SHOURAI UCHUUKI NO SHIKEN GIJUTSU NI KANSURU KENKYUU] **c18**

Takeshi Matsuoka, Chikashi Sasamura, and Tetsuya Inagaki *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 191-194 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

An overview of the research on advanced spacecraft testing technology is presented. Review on test technologies required for future space activities was conducted on the subjects such as sinusoidal vibration, modal survey, acoustic, deployment function, thermal vacuum and thermal balance, and large high performance sensor evaluation testing was conducted, and problems to be solved were pointed out. Modal data acquired by base vibration were evaluated with the results of numerical analyses. Research on large high performance optical sensor test technology for acquiring and evaluating vibration data in ambient temperature and pressure was conducted. Author (NASDA)

N93-20453# National Space Development Agency, Ibaraki (Japan). Tracking and Control Center.

RESEARCH ON GPS UTILIZATION IN SPACE [GPS NO UCHUU RIYOU NO KENKYUU] **c04**

Atsushi Tsuchiya and Shinichi Ishikawa *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 195-200 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A02/MF A03

An overview of the survey of the US documents concerning space utilization of the Global Positioning System (GPS) is presented in the following aspects: (1) GPS utilization forms; (2) GPS utilization in space; (3) characteristics required by utilization subjects such as geostationary, high altitude orbit, long elliptic, satellite in below medium altitude orbits, and rendezvous and docking, launch vehicles, and time synchronization; (4) position accuracy by GPS; and (5) problems for GPS utilization. Author (NASDA)

N93-20454# National Space Development Agency, Ibaraki (Japan). First Operations Div.

EVALUATION AND ANALYSIS OF LONG TERM SATELLITE OPERATION DATA [JINKOU EISEI CHOUKI UNYOU DETA NO HYOUKA KAISEKI] **c18**

Shuuji Naitou, Hirohito Sarai, Masakatsu Yamawaki, Ryouichi Anzai, Eiichi Koyama, and Ryouji Kobayashi *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 201-204 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

An overview of the evaluation and analysis of the satellites launched by NASDA, such as the Broadcasting Satellite-2b and 3a (BS-2b and 3a), Communications Satellite-3a and 3b (CS-3a and 3b), Experimental Geodetic Satellite (EGS), Engineering Test Satellite-5 (ETS-5), Geostationary Meteorological Satellite-3 and 4 (GMS-3 and 4), and Marine Observation Satellite-1 and 1b (MOS-1 and 1b) is presented. Appropriateness of the analyses of performance characteristics, analyses on long term data variation, and design and testing verification were conducted. Integration of operations and collection and evaluation of the test results were conducted on BS-2b residual fuel verification test, the ETS-5 Tracking, Telemetry and Command Subsystem (TTC), Attitude Control System (ACS), and Thermal Control Subsystem (TCS) experiment operations. Development and maintenance of analysis programs were conducted on the Japanese Earth Resources Satellite-1 (JERS-1), data output program for personal computers, satellite generated power analysis program, and additional functions for the existing programs. Collection, compression, storage, compilation, and output of the operation data were conducted. Author (NASDA)

N93-20455# National Space Development Agency, Ibaraki (Japan). First Operations Div.

OPERATIONAL SUPPORT FOR ETS-5 SECONDARY OPERATIONAL PHASE [ETS-5 NO KOUKI DANKAI NO UNYOU SHIEN] **c18**

Susumu Wakabayashi, Shinji Kawano, and Masakatsu Yamawaki *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 205-208 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

An overview of the technical support conducted from April 1991 to March 1992 for secondary operational term of the Engineering Test Satellite-5 (ETS-5) and the technical support for bus equipment experiment planning are presented. Technical support was conducted on telemetry data quick review to correctly judge the operation status in periodical function checks of the Tracking, Telemetry, and Command (TTC) subsystem, the Simulated Component in Thermal Verification Tests (CVT), and the electronic system assembly and noise source verification test. Technical support for reviews on operation procedure and fundamental operational problems and cautions for operation was conducted. As the results of operation support, long-term trend evaluation of the operational characteristics of each subsystems and data acquisition required for ESA (Earth Sensor Assembly) noise source verification of the Attitude Control System (ACS) could be achieved. Support for battery reconditioning and yaw-axis angular momentum (Hz) bias value change planning was conducted to satisfactorily run satellite operation and maintenance control. Author (NASDA)

N93-20456# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.

DEVELOPMENT OF HIGH HEAT RADIATION PRINTED BOARDS Report No. 2 [KOUHOUNETSU PURINTOBAN NO KAIHATSU] **c33**

Shigeo Shiota, Masahiro Nakao, Tooru Kanno, and Akira Shimizu *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 209-212 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

An overview of the development conducted on printed boards is

presented. Data of the heat-shock-resistant properties at various through hole diameters, board materials, and plating thickness were obtained on Copper Inver Copper (CIC) Multi Wire Circuit Boards (MWB) which are most sensitive thermally. The print board heat radiation characteristics were evaluated. The results of conducting tests, such as heat shock, hot oil, radiation, and out gassing tests are presented. Reliability assurance program was established to establish manufacturing process preparing procedures, standards, and control documentation. Author (NASDA)

N93-20457# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.

REVIEW ON ALUMINUM ELECTROLYTIC CONDENSERS DEVELOPMENT Report No. 3 [ARUMI DENKAI KONDENSA NO KAIHATSU KENTOU] **c33**

Shigeo Shiota, Masahiro Nakao, Muneaki Nakai, and Akira Shimizu *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 213-216 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the design, trial production and test, and reliability evaluation test of aluminum electrolytic condensers is presented. Material design was established after conducting various evaluation tests and analyses, such as life tests (6,000 hours at 125 C) and evaluation of the generated gases on components produced in material design implemented until previous fiscal year. Trial production and evaluation on two structural designs which are deemed to give better operability satisfying safety design requirements among five designs proposed previous fiscal year were conducted and the one with best operability was determined. The condensers produced after the design determined by the above evaluation were tested and evaluated for resistance against environments, such as vibration, shock, radiation, and thermal shock. Author (NASDA)

N93-20458# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.

IMPROVEMENT OF LC FEEDTHROUGH FILTERS Report No. 1 [LC KANTSUUGATA FIRUTA NO KAIRYOU] **c33**

Shigeo Shiota, Masahiro Nakao, and Akira Shimizu *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 217-220 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the trial production and evaluation tests for improving the existing LC feedthrough filters is presented. Random vibration (in accordance with MIL-STD-202 Test Method 214) and thermal shock tests (in accordance with MIL-STD-202 Test Method 107) were conducted on four kinds of the existing qualified filters to determine their necessity for improvement. Trial production and evaluation test were conducted on filters produced in accordance with the draft specifications prepared base on the results of the above evaluation tests, and the same environment tests as the above were conducted to determine whether they can be adopted or they must undergo further improvement. Author (NASDA)

N93-20459# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.

REVIEW ON SURFACE MOUNTING COMPONENTS (WIRE WOUND CHIP RESISTORS) DEVELOPMENT [HYOUMEN JISSOU BUHIN (MAKISEN CHIPPU TEIKOU) NO KAIHATSU KENTOU] **c33**

Shigeo Shiota, Masahiro Nakao, and Akira Shimizu *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 221-224 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the development review on surface mounting components (wire wound chip resistors) is presented. Temperature rise tests were conducted on wire wound chip resistors installing them on substrates made of alumina, glass epoxy resin, or polyimide to determine their temperature rise characteristics, and maximum load factors were determined taking substrate heat resisting temperature and solder melting temperature into consideration. Evaluation tests were conducted on the filters' resistance to environments (thermal shock, anti hydroscopicity, thermal stability, loaded life, shock, random vibration, radiation resistance, out gassing), and the subject filters functioned satisfactory with exception of difficulty of conducting the thermal stability test at 125 C which was lower than the temperature specified in the NASDA's (National Space Development Agency of Japan's) specification due to problems of heat resistance of the molding resin material. Author (NASDA)

N93-20460# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.

DEVELOPMENT OF TRANSISTORS (EQUIVALENT TO 2SC3321) [TORANJISUTA (2SC3321 SOUTOU) NO KAIHATSU] **c33**

Sumio Matsuda, Takashi Tamura, and Masato Uesugi *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 225-226 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the development of power transistors named NASDA (National Space Development Agency of Japan) 2SC4832 is presented. Trial production and evaluation were conducted on improved version of industrial power transistor 2SC3321 to establish the design. Reliability assurance program was established documenting manufacturing method, test methods, equipment management and emergency measure systems, and so forth for the transistors under development required to establish stable supply system. Samples to be subjected to the tests were produced. Development verification corresponding to the qualification test specified by NASDA-QTS-19500A specification, and data required for qualification were acquired. Characteristics evaluation test was conducted to obtain fundamental data for the application data sheets. Specific specification and application data sheets for the subject transistor were prepared. Author (NASDA)

N93-20461# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.

DEVELOPMENT OF POWER MOSFET (150 W CLASS) Interim Report [PAWA MOSFET (150 WATTO KURASU) NO KAIHATSU] **c33**

Satoshi Kuboyama, Takashi Tamura, Masato Uesugi, and Tooru Kanno *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 227-228 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the power Metal Oxide Semiconductor (MOS) Field Effect Transistor (FET) is presented. Development was being conducted to upgrade radiation resistance without impairing electrical characteristics and to improve chip process design for decreasing on resistance by trading off with switching speed (device capacity) and small package design. Chip design were conducted to decrease the process temperature for increasing total dose resistance, suppress parasitic transistor behavior for augmenting single event resistance, and optimize FET cell structure and dimension for decreasing on resistance. Evaluation test of the trial produced samples was conducted. Package materials were selected and their assembly technologies were established. Evaluation test was conducted especially focusing on the effects of bonding and sealing property, and lead forming. The possibility to provide the engineering model to the JEM (Japanese Experiment Module) project was obtained. Author (NASDA)

N93-20462# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.

IMPROVEMENT OF VOLTAGE REFERENCE ZENER DIODE (1SZ48A) [DENATSU HYOUJUN TSENADAIODO (1SZ48A) NO KAIRYOU] **c33**

Takashi Tamura, Masato Uesugi, and Masato Nakajima *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 229-234 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A02/MF A03

An overview of the improvement conducted on space glass diodes is presented. Design evaluation was conducted on new packages with ceramic packaging and gold line bonding. Two chips structure was adopted after examining various combinations between the junction protection films, kinds of electrodes, and forming methods, and the reliability of the different metal junction between gold and silver was verified. Sample production and various tests were conducted after establishing the design, reviewing reliability assurance program based on the review results, and it was confirmed there was no problem in both of design and manufacturing

process. The specific specification and application data were reviewed based on the test results. Author (NASDA)

N93-20463# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.

DEVELOPMENT OF HIGH SPEED RECTIFIER DIODES Interim Report [KOUSOKU SEIRYUU DAIODO NO KAIHATSU] c33

Takashi Tamura, Masato Uesugi, and Masato Nakajima *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 235-238 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of high speed rectifier diode development is presented. Chip design as a consequence of the type change to planar type and review on gold dispersion condition to get higher speed chips were conducted. A review was conducted on mounting to the package and wire bonding. Evaluation samples at three levels were trial produced and their design evaluation test was started. Author (NASDA)

N93-20464# National Space Development Agency, Tokyo (Japan). Parts and Material Management Office.

REVIEW ON SCHOTTKY BARRIER DIODE DEVELOPMENT [SHOTTOKI BARIA DAIODO NO KAIHATSU KENTOU] c33

Satoshi Kuboyama, Takashi Tamura (National Space Development Agency, Ibaraki, Japan.), and Mitsuhiro Nakamura (National Space Development Agency, Ibaraki, Japan.) *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 239-242 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the survey and research on Schottky barrier diodes is presented. Examination on total dose resistance of industrial products at seven total dose levels from 0.1 to 100 KGy (Si) was conducted and no deterioration was noticed even at 100 KGy (Si). Design and trial production were conducted satisfactorily on Schottky barrier diodes of an output current of 3 A. Deposited electrode process was established by applying decompression force by double heat sinking. Review on package design by various simulations to select outer dimensions and the availability of ingredient components was conducted. Author (NASDA)

N93-20465# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.

REVIEW ON OPTICAL ELEMENTS FOR INTERSATELLITE LASER COMMUNICATION [EISEIKAN REZA TSUUSHINYOU HIKARI SOSHI NO CHOUSA KENKYUU] c36

Takashi Tamura, Tooru Kanno, and Mitsuhiro Nakamura *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 243-246 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the study on optical elements for intersatellite laser communication is presented. High speed laser diodes were produced from five manufacturers to examine the manufacturing capability, and their characteristics and individual data were acquired. Optical characteristics on 21 items, including L-I (Light Power-Current) and dL/dI characteristics, temperature dependency of slop efficiency and oscillation spectrum, polarization ratio, astigmatism, wavefront aberration, and so forth of the laser diodes were acquired individually. The data acqured were evaluated and the examples of the current via optical characteristics, far field patterns, and optical spectra were shown. Author (NASDA)

N93-20466# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.

REVIEW ON UPGRADING EFFICIENCY OF SILICON SOLAR BATTERY CELLS Report No. 1 [SHIRIKON TAIYOU DENCHI SERU NO KOUKOURITSUKA NO KENTOU] c33

Sumio Matsuda, Takashi Tamura, and Masato Uesugi *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 247-248 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the study on upgrading efficiency of silicon solar battery cells is presented. Review on the following subjects was conducted to upgrade conversion efficiency of solar battery cells: (1) selection of silicon wafers paying attention to resistivity and production methods; (2) diffusion process, including passivation at the front and rear surfaces; (3) contact configurations between electrodes and silicon at the front and rear surfaces; (4) reduction of front surface electrode area; and (5) methods for forming reflecting electrodes on the rear surface of the silicon. Samples for the integrated evaluation test were trial produced. Data concerning electric output and optical characteristics, and of the electron beam irradiation test were acquired, and the possibility of high efficiency solar battery was verified. Author (NASDA)

N93-20467# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.

DEVELOPMENT OF RADIATION RESISTANT HCMOSIC Interim Report [TAIHOUSHASENSEI HCMOSIC NO KAIHATSU] c33

Masato Nakajima, Takashi Tamura, Masato Uesugi, and Satoshi Kuboyama (National Space Development Agency, Tokyo, Japan.) *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 249-252 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the development of radiation resistant Highly Complementary Metal Oxide Semiconductor Integrated Circuit (HCMOSIC) is presented. The development of 15 items of HCMOSIC's to increase their radiation resistance applying measures determined by the past researches was being carried out with a target radiation resistance of 10 KGy. Each item has to undergo design, establishment of manufacturing processes and reliability assurance programs, sample production, and development verification test in parallel with radiation resistance, characteristics and reliability evaluation tests. Nine items out of 15 underwent the development verification test satisfactorily and samples for the other six were being produced. An example of major characteristics of the developed IC (Integrated Circuit) is shown. Author (NASDA)

N93-20468# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.

DEVELOPMENT OF RADIATION RESISTANT LINEAR IC (EQUIVALENT TO MU PC 806) [TAIHOUSHASENSEI RINIA IC (MYU PC 806 SOUTOU) NO KAIHATSU] c33

Masato Nakajima, Takashi Tamura, Masato Uesugi, and Satoshi Kuboyama (National Space Development Agency, Tokyo, Japan.) *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 253-256 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the development of radiation resistant linear Integrated Circuits (IC's) is presented. Trial production and evaluation on L-PNP (Linear Positive-Negative-Positive junction) and Pch-Junction Field Effect Transistor (JFET) with a target radiation resistance of 1 KGy (Si) were conducted to determine the correlation between their oxidizer substrate thickness and h field effect decrease. Design of an operation amplifier was conducted aiming at substituting without circuit design change from and with the same outer dimensions and characteristic standards as the conventional IC's based on the results of the above evaluation and production of its test samples was started. Author (NASDA)

N93-20469# National Space Development Agency, Tokyo (Japan). Parts and Material Management Office.

DEVELOPMENT OF HIGH DENSITY HYBRID IC Interim Report [KOUMITSUDO HAIBURIDDO IC NO KAIHATSU] c33

Satoshi Kuboyama, Takashi Tamura (National Space Development Agency, Ibaraki, Japan.), Masato Uesugi (National Space Development Agency, Ibaraki, Japan.), and Jirou Aoki (National Space Development Agency, Ibaraki, Japan.) *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 257-258 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the development of high density hybrid Integrated Circuits (IC's) is presented. Preliminary evaluation of technologies, such as photoetching and aluminum nitride substrate technologies for high density hybrid IC's were being conducted to acquire various data required for hybrid IC design and preliminary evaluation on aging (life test), bondability,

and so forth were being conducted on the evaluation samples. Micro wiring rule, and components and packages were examined using thin substrate etching technology for developing high density eight bit A/D (Analogue to Digital) converters (1 inch by 1 inch metal package), and their fundamental design was determined. Author (NASDA)

N93-20470# National Space Development Agency, Tokyo (Japan). Parts and Material Management Office.

DEVELOPMENT OF 256 KBIT PROM Interim Report [256 KIRO BITTO PROM NO KAIHATSU] **c33**

Satoshi Kuboyama, Takashi Tamura (National Space Development Agency, Ibaraki, Japan.), Masato Uesugi (National Space Development Agency, Ibaraki, Japan.), and Tooru Kanno (National Space Development Agency, Ibaraki, Japan.) *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 259-260 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the development of 256 kbit Programmable Read Only Memory (PROM) in the sealing glass sections is presented. Sample packages were trial produced to secure clearances between inner wires and outer leads. They were undergoing thermal stress and leak tests to optimize sealing structures and conditions. Chips were trial produced and underwent radiation resistance test, and the effects of measures for the U groove isolation leakage were verified. Temperature evaluation test was being conducted to optimize the threshold voltage of Metal Oxide Semiconductor (MOS) transistors. Author (NASDA)

N93-20471# National Space Development Agency, Tokyo (Japan). Parts and Material Management Office.

DEVELOPMENT OF 256 KBIT SRAM Interim Report [256 KIRO BITTO SRAM NO KAIHATSU] **c33**

Satoshi Kuboyama, Takashi Tamura (National Space Development Agency, Ibaraki, Japan.), and Mitsuhiro Nakamura (National Space Development Agency, Ibaraki, Japan.) *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 261-264 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the surveys on the following subjects on 256 kbit Static Random Access Memories (SRAM's) is presented: (1) stable supply of the products by examining the electric properties by parameters, such as gating oxide substrate thickness and V(sub th) of activated Metal Oxide Semiconductor (MOS); (2) annealing temperature after gating oxide substrate formation and highly resistant Poly Si stability to examine the capability to resist the total dose and the possibility of upgrading the dose resistance; (3) Single Event Upset (SEU) and Single Event Latch-up (SEL); (4) establishment of manufacturing process (reliability assurance program) based on NASDA-QTS-38510A specification; and (5) implementation of various tests (development verification, accelerated life, and characteristics verification test). Author (NASDA)

N93-20472# National Space Development Agency, Tokyo (Japan). Parts and Material Management Office.

DEVELOPMENT OF 10 k GATE-GATE ARRAY Report No. 1 [10 KIRO GETO GETO AREI NO KAIHATSU] **c33**

Satoshi Kuboyama, Sumio Matsuda (National Space Development Agency, Ibaraki, Japan.), and Yasuhiro Aikawa (National Space Development Agency, Ibaraki, Japan.) *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 265-266 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the activities for 10 k gate-gate array development is presented on the following subjects: (1) process improvement for upgrading radiation resistance; (2) establishment of Computer Aided Design (CAD) tools; (3) preparation of design manuals (for users); (4) establishment of lot evaluation samples based on the above tools and manuals; (5) establishment of production process; (6) establishment of reliability assurance program; (7) establishment of methods for quality assurance; (8) production of samples for development verification test; (9) implementation of development verification test; (10) implementation of characteristics evaluation test; (11) preparation of specific specifications and application sheets; and (12) extending users' interfaces. Author (NASDA)

N93-20473# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.

DEVELOPMENT OF 32 BIT MPU Interim Report [32 BITTO MPU NO KAIHATSU] **c33**

Masato Nakajima, Takashi Tamura, Masato Uesugi, and Satoshi Kuboyama (National Space Development Agency, Tokyo, Japan.) *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 267-270 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the process of the activities for developing 32 bit Micro Processor Units (MPU's) is presented. Design and trial production of the packages were conducted. Determination of soldering conditions necessitated by changing lead plating material from gold to solder, review of manufacturing process conditions, preparation of process documents, and establishment of draft quality assurance program are described. Author (NASDA)

N93-20474# National Space Development Agency, Tokyo (Japan). Parts and Material Management Office.

REVIEW ON RADIATION RESISTANT 32 BIT MPU Report No. 2 [TAIHOUSHASENSEI 32 BITTO MPU NO KENTOU] **c33**

Satoshi Kuboyama, Takashi Tamura (National Space Development Agency, Ibaraki, Japan.), and Mitsuhiro Nakamura (National Space Development Agency, Ibaraki, Japan.) *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 271-278 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A02/MF A03

An overview of the survey and research conducted on the following subjects concerning radiation resistant 32 bit Micro Processor Units (MPU's) is presented: (1) limits of resistance for process improvement specification determined last fiscal year; (2) proving that P-Si3N4 produced total dose resistance improvement; (3) elucidation of degradation due to total dose and Single Event Upset (SEU) phenomena; (4) establishment of new sealing method because of low heat resistance of P-Si3N4; and (5) design review of the package. Author (NASDA)

N93-20475# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.

SURVEY AND REVIEW ON ADHESIVES [SECCHAKUZAI NO CHOUSA KENTOU] **c27**

Tadaaki Kurosaki and Takashi Watanabe *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 279-283 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

The used records of adhesives by 11 space equipment manufacturers were examined by adhesive classifications, names of the manufacturers, applications, and examples of discrepancies encountered. The survey showed that epoxy, urethane, and acrylic resin were mainly used as space adhesives and their delivery time, available quantity for procurement, price and delivery time reduction, and stable supply were great issues because all of them were foreign made. Factory survey was conducted on four adhesive manufacturers for classifications, use records in space and astronautics areas, quality control capability, and supply stability. Though their experience in space and astronautics areas was very few, there was no problem in every aspect of quality control and product evaluation systems, technical capability, and supply stability. Author (NASDA)

N93-20476# National Space Development Agency, Ibaraki (Japan). Common Equipment Lab.

RESEARCH ON LARGE CAPACITY Ni-Cd BATTERIES [DAIYOURYOU NI-CD BATTERI NO KENKYUU] **c33**

Saburou Kuwashima, Norimitsu Kamimori, Kazuhiro Uchiyama, and Hiroaki Kusawake *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 285-288 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the research on large capacity (capacity 25 to 50 AH) Ni-Cd batteries is presented. The fundamental design of 25 to 40 AH cells was changed as follows: (1) oily agent removal separators were adopted; (2) polymerization process was applied to the cathodes; (3) electrolytic solution more than equivalent to that for qualification test cells; (4) electrode

thickness of the 50 AH cells was increased to increase the capacity ratio; and (5) the height of the 25 AH cells was changed to 89.3 mm to acquire design data for setting up capacity series for the battery based on the data of 35 AH cells already developed. Cells with different parameters were designed to study on factors affecting to their life characteristics. The following mechanical strength tests were conducted on 50 AH cells with the dimensions, terminal cover, and case plate thickness changed from those of the 35 AH cells: (1) destruct pressure test; and (2) cycling test. Initial electric characteristics test simular to that for 35 AH cells was conducted. Author (NASDA)

N93-20477# National Space Development Agency, Ibaraki (Japan). Common Equipment Lab.

RESEARCH ON Ni-H2 BATTERIES [NI-H2 BATTERI NO KENKYUU] **c33**

Saburou Kuwashima, Norimitsu Kamimori, and Kazumichi Takahashi *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 289-292 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the research on Ni-H2 batteries is presented. Eighteen cells including nine Electrochemically Impregnated (EI) and nine Chemically Impregnated (CI) were trial produced and subjected to the development verification test, such as electric characteristics and mechanical environment tests. The following characteristic tests were conducted: (1) low starting cycle; (2) continuous supercharging; (3) shelf life; (4) self-discharge; (5) charging efficiency; (6) discharging efficiency; (7) - 15 C characteristic; and (8) limiting characteristics. Post development verification test review was conducted to verify the appropriateness of the design and manufacturing process. Reviews on the design and electrode manufacturing technology were conducted to facilitate enlarging the batteries. Life evaluation test was conducted on Engineering Model (EM) cells trial produced in fiscal year 1900 by Ni-H2 battery evaluation test equipment in Tsukuba Space Center of NASDA (National Space Development Agency of Japan).
Author (NASDA)

N93-20478# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.

ESTABLISHMENT OF HIGH DENSITY INSTALLATION TECHNOLOGY Report No. 2 [KOUMITSUDO JISSOU GIJUTSU NO KAKURITSU] **c33**

Shigeo Shiota, Masahiro Nakao, Muneaki Nakai, and Akira Shimizu *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 293-296 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the research on optimum processes for soldering is presented. Review of high reliability soldering materials was conducted on tin system solder. Thermal shock evaluation test was conducted on cubic chip resistors to evaluate the effects of soldering materials, fillet configurations, component configurations, and substrate materials to the reliability of junction points. Review for solving problems was conducted on migration property of soldering materials and cleanliness of the soldered joint. Some factors for developing life projecting technology for soldered joint were described. Author (NASDA)

N93-20479# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.

SOLAR CELL CALIBRATION BY BALLOON FLIGHT [TAIYOU DENCHI SERU NO BARUN FURAITO NI YORU KOUSEI] **c44**

Sumio Matsuda, Takashi Tamura, and Masato Uesugi *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 297-298 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the manufacture and calibration by balloon flight of primary standard solar batteries is presented as follows. Primary standard solar battery cells of micro N electrode Back Surface Reflector (BSR) and micro N electrode Back Surface Field and Reflector (BSFR) type were produced, and primary solar battery modules of both types were assembled each with four cells selected from the center of characteristics distributions. Each two modules of both types manufactured and each two modules of primary standard battery cells, composed of gallium arsenide (GaAs) and outmoded BSFR cells which had to undergo re-calibration was calibrated by balloon flights. Author (NASDA)

N93-20480# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.

REVIEW ON PARTS TEST DATA ANALYZING SYSTEM [BUHIN SHIKEN DETA KAISEKI SHISUTEMU NO KENTOU] **c18**

Takashi Tamura, Masato Uesugi, and Kouichi Suzuki *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 299-302 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the review on Parts Test Data Analysis System (PAS) is presented. Survey of PAS requirements was conducted mainly on the measuring items and test conditions for semiconductor components radiation tests, such as total dose and single event tests. Review was conducted on hardware and software preparation plans of PAS for users limited within the Parts and Materials Laboratory of NASDA (National Space Development Agency of Japan). The drafts of system specification and development program were prepared based on the results of the system requirement survey. Survey on application formats for data management based on the results of system requirement survey, and the formats were verified to be effective by inputting real test data. Author (NASDA)

N93-20481# National Space Development Agency, Tokyo (Japan). Parts and Material Management Office.

INDUSTRIAL IC EVALUATION TEST: 256 KBIT EEPROM [MINSEIHIN IC NO HYOUKA SHIKEN: 256 KIRO BITTO EEPROM] **c33**

Satoshi Kuboyama and Tooru Kanno (National Space Development Agency, Ibaraki, Japan.) *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 303-306 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the evaluation test conducted on industrial Integrated Circuits (IC's) is presented. Industrial Electrically Erasable and Programmable Read Only Memory (EEPROM) was selected as test samples. Each five samples were irradiated with gamma ray by Co-60 at three levels of 0.3, 1, and 3 kGy (Si). Device condition at the irradiation was in stand by mode after writing checker flag patterns on the base. Nine measurements were conducted on characteristics, such as function, electric source current, input current, output voltage, access time, and threshold voltage. Resistances possessed by, deteriorated sections of, and deterioration mechanisms of the devices were determined as the result of the above test.
Author (NASDA)

N93-20482# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.

RADIATION RESISTANCE EVALUATION TEST ON PARTS AND MATERIALS: SOLAR BATTERY CELL [BUHIN ZAIRYOU NO TAIHOUSHASEN HYOUKA: TAIYOU DENCHI SERU] **c33**

Sumio Matsuda, Takashi Tamura, and Masato Uesugi *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 307-308 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of acquisition and analysis of (retro) annealing phenomena caused on solar battery cells by exposing them to a temperature equal to or more than 130 C is presented. Si battery cell lattice change data was acquired by the Deep Level Transient Spectroscopy (DLTS) at Tsukuba University, and the annealing characteristics were that the higher the annealing temperature was, the shorter the time was required to get to saturation. Data of the Solar Cell Monitor (SCM) onboard the Engineering Test Satellite-5 (ETS-5) were analyzed, and deterioration caused by large solar flares could observed with Si solar cell 200 micro meter. Comparison of expected data with real measured data was being conducted base on the data acquired by the radiation monitor onboard ETS-5.
Author (NASDA)

N93-20483# National Space Development Agency, Tokyo (Japan). Parts and Material Management Office.

RESEARCH ON SINGLE EVENT RESISTANCE EVALUATION TECHNOLOGY: RESEARCH BY HEAVY ION IRRADIATION [SHINGURU IBENTO TAISEI NO HYOUKA GIJUTSU NO KENKYUU: JYUURYUUSHI ION SHOUSHA NI YORU KENKYUU] **c33**

Satoshi Kuboyama, Takashi Tamura (National Space Development Agency, Ibaraki, Japan.), Yousuke Shimano (National Space Development Agency, Ibaraki, Japan.), Masato Uesugi (National Space Development Agency, Ibaraki, Japan.), Masato Nakajima (National Space Development Agency, Ibaraki, Japan.), Mitsuhiro Nakamura (National Space Development Agency, Ibaraki, Japan.), and Tooru Kanno (National Space Development Agency, Ibaraki, Japan.) *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 309-314 In JAPANESE Prepared in cooperation with Japan Atomic Energy Research Inst., Tokai (For primary document see N93-20410 07-12)

Avail: CASI HC A02/MF A03

Joint research with the Japan Atomic Energy Research Institute (JAERI) was conducted on phenomena called Single Event Burn-Out (SEB) and Single Event Latch-up (SEL) occurred on power Metal Oxide Semiconductor Field Effect Transistor (MOSFET), and Static Random Access Memory (SRAM) was conducted based on the results of researches conducted utilizing the Cf-252 irradiation facility installed at Tsukuba Space Center of NASDA (National Space Development Agency of Japan). Specifications and fundamental structure of the power MOSFET and SRAM subjected to the research were shown. A measuring system called Energetic Particle Induced Charge Spectroscopy (EPICS) with a special charge amplifier as its center was developed to measure characteristics of SEB, phenomenon for which evaluation technology was not established, and heavy ion irradiation was conducted by the tandem Van de Graaff accelerator located at JAERI. More detailed elucidation of single event phenomenon peculiar to space could be made possible. Author (NASDA)

N93-20484# National Space Development Agency, Tokyo (Japan). Parts and Material Management Office.

RESEARCH ON SINGLE EVENT RESISTANCE EVALUATION TECHNOLOGY: SINGLE EVENT RESISTANCE EVALUATION BY SEM [SHINGURU IBENTO TAISEI NO HYOUKA GIJUTSU NO KENKYUU: SEM NI YORU SHINGURU IBENTO TAISEI NO HYOUKA] **c33**

Satoshi Kuboyama and Jirou Aoki (National Space Development Agency, Ibaraki, Japan.) *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 315-320 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A02/MF A03

Single event evaluation, generation spot determination, and analysis of the generation mechanism could be made in detail by a Scanning Electron Microscope (SEM). Single event evaluation tests were conducted on latching circuits of 4 bit slicing micro processor by digital scanning equipment, and satisfactory data and results were obtained. The beam blanking SEM used in the tests has composition of conventional SEM incorporated with electrostatic deflection type high-speed beam blanking equipment. Electron beams irradiated from the electron gun by impressing pulse voltage on the electrostatic deflection device can be irradiated on the test subject samples. Results of inversion cross section area and the dependency of inversion cross sections on beam current were measured. The inversion cross section areas obtained by the SEM method were larger than the above results. Analyzing the test results, it was made clear that the evaluation method can not only equal to other methods but enable to analyze the inversion occurrence mechanism of each sample, spot the location where inversion occurs. It was made clear that a single event evaluation method by SEM can be an alternative for conventional evaluation methods.

Author (NASDA)

N93-20485# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.

RESEARCH ON SINGLE EVENT PHENOMENON ON SEMICONDUCTOR DEVICES Report No. 6 [HANDOUTAI DEBAISU NO SHINGURU IBENTO NI KANSURU KENKYUU] **c33**

Sumio Matsuda, Takashi Tamura, and Masato Uesugi *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 321-324 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the research on three themes of single event phenomenon on semiconductor devices is presented. Data acquisition and analysis were conducted on transient current waveforms generated on PN (Positive-Negative) alloy junctions by the helium ion microbeam equipment of the Electrotechnical Laboratory, Agency of Industrial Science and Technology. A new superconducting delay line was trial produced to prevent waveform deformation caused by impedance mismatching of the one produced last year. Conducting helium irradiation by the above microbeam equipment and the improved delay line, band spreading of the experiment system could be attained and collected charges could be acquired more accurately. Single Event Upset (SEU) saturation cross section data of domestic Complementary Metal Oxide Semiconductors (CMOS) Static Random Access Memory (SRAM) and bipolar Flip Flop (FF) were acquired by Cf-252 after causing deterioration on them by the total dose effect of Co-60 gamma ray. Related documents were examined and up-to-date information concerning advanced evaluation and analysis techniques and manufacturing processes for resistance improvement were collected.

Author (NASDA)

N93-20486# National Space Development Agency, Tokyo (Japan). Parts and Material Management Office.

CONSTRUCTION OF EVALUATION TEST EQUIPMENT FOR 16 BIT SPACE MPU [UCHUUYOU 16 BITTO MPU HYOUKA SHIKEN SOUCHI NO SEIBI] **c33**

Satoshi Kuboyama, Yasuhiro Aikawa, and Jirou Aoki *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 325-326 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the construction of the evaluation test equipment for a 16 bit Micro Processor Unit (MPU) is presented. It is necessary to combine many factors systematically, such as software development tools and In Circuit Emulators (ICE), as well as 16 bit MPU itself for developing computer systems with 16 bit space MPU's, and the evaluation test equipment was developed for the purpose of supporting the factors, determining the cause of discrepancies, and conducting rapid directions of corrective actions to several manufacturers at a time. The software is a general purpose cross software to facilitate efficient objective program production, simulation, and source level debug. The hardware consists of lap top Engineering Work Station (EWS) and an evaluation board to simulate MPU and its surrounding hardware in developing computer systems equipped with 16 bit space MPU.

Author (NASDA)

N93-20487# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.

SAFETY VALIDATION TEST EQUIPMENT OPERATION [ANZENSEI JISSHOU SHIKEN SETSUBI NO UNYOU] **c14**

Tadaaki Kurosaki and Takashi Watanabe *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 327-330 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

An overview of the activities conducted on safety validation test equipment operation for materials used for NASA manned missions is presented. Safety validation tests, such as flammability, odor, offgassing, and so forth were conducted in accordance with NASA-NHB-8060.1C using test subjects common with those used by NASA, and the equipment used were qualified for their functions and performances in accordance with NASDA-CR-99124 'Safety Validation Test Qualification Procedures.' Test procedure systems were established by preparing 'Common Procedures for Safety Validation Test' as well as test procedures for flammability, offgassing, and odor tests. The test operation organization chaired by the General Manager of the Parts and Material Laboratory of NASDA (National Space Development Agency of Japan) was established, and the test leaders and operators in the organization were qualified in accordance with the specified procedures. One-hundred-one tests had been conducted so far by the Parts and Material Laboratory according to the request submitted by the manufacturers through the Space Station Group and the Safety and Product Assurance for Manned Systems Office. Author (NASDA)

N93-20488# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.
REVIEW ON SAFETY VALIDATION TEST [ANZENSEI JISSHOU SHIKEN NI KANSURU KENTOU] c18
Tadaaki Kurosaki and Takashi Watanabe *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 331-334 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

Flammability, odor, and off-gas characteristics tests have been conducted for the purpose of evaluating and selecting materials used for the Japanese Experiment Module (JEM) to be attached to the space station Freedom, and efforts have been exerted to establish safety validation test technology by conducting survey and review on test methods and operation technologies. The results of the tests are as follows: (1) it was decided that standard gases would be produced by the same mass ratio mixing method as that for producing intermediate gases, prepare two kinds of standard gas containers made from manganese steel and aluminum, and then analyze the gases by gas chromatography FID (Flame Ionization Detector) method and gas chromatography mass spectrography every zero, one, three, and six months; (2) the odor in the odor test chamber of the odor test equipment was examined and it was made clear that it could be dealt with by operation; (3) on testing gas generation containers made from glass, absorption of ingredients except for alcohols and aldehydes and pollution by silicon grease and sealing materials were noticed, and replacement with stainless steel containers was deemed desirable as those for off-gas testing; (4) four articles in the arc tracking test procedures were revised; and (5) the requirement specifications for ignitors for flammability testing, manufacturing conditions, and equipment required for manufacturing were made clear. Author (NASDA)

N93-20489# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.
OUTLINE OF SCM DATA PROCESSING SYSTEM ONBOARD ETS-5 [ETS-5 SCM DETA SHORI SHISUTEMU NO GAIYOU] c35
Sumio Matsuda, Takashi Tamura, and Masato Uesugi *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 335-336 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

An overview of the operation of the Solar Cell Monitor (SCM) is presented. In minicomputer, SCM data are extracted from the telemetry data, data distribution at 17:00 (Japan Standard Time) plus or minus 15 minutes when the SCM entrance surface directly faces to the sun were obtained, SCM data sent in hexadecimal number system were engineeringly converted to analog values, and the results are recorded in each solar cell file. The data processed by mini computer are sent to personal computer through in site telephone circuit, and the data undergo the following three compensations: (1) for solar ray intensity variation due to the elliptic earth revolution orbit; (2) for the seasonal variation of angles between SCM entrance surface and the sun caused by the inclination of the earth's axis; and (3) for seasonal SCM temperature variation. Author (NASDA)

N93-21070# Canadian Space Agency, Ottawa (Ontario). Space Science Program.
SPACEBOUND 1991 [OBJECTIF ESPACE 1991]
1991 309 p In ENGLISH and FRENCH Conference held in Ottawa, Ontario, 29-30 Apr. 1991; sponsored by CSA and NRCC
(CTN-93-60604) Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

A space sciences conference presented papers on projects undertaken in the Canadian space program, crystal growth in microgravity conditions, radiation protection in space, fluid physics in microgravity conditions, the effects of low gravity on organisms, experimental programs undertaken on parabolic flights, synthesis and processing of composite materials in low gravity, human physiology under changing gravity, production and processing of glass, ceramics, metals, and alloys in microgravity, and laser material processing in low and high gravity conditions. Separate abstracts have been prepared for 57 papers from this conference. For individual titles, see N93-21071 through N93-21127.

N93-21071# Canadian Space Agency, Ottawa (Ontario).
SPACE SCIENCE OVERVIEW
Barry L. Wetter *In its* Spacebound 1991 1991 p 3-8 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

The Space Science Program of the Canadian Space Agency has the objective of ensuring that Canada maintains a position of excellence in the worldwide scientific exploration of space. The program provides opportunities for Canadian scientists and engineers to participate in quality national and international space projects in the disciplines of space physics, atmospheric chemistry, astronomy and life, and materials sciences in microgravity. Another objective of the program is to enhance Canadian industrial capabilities in space technology. The history of space science research in Canada is reviewed, from the early ground-based and balloon or rocket observations of northern latitude phenomena, to the development of the Alouette satellite and international cooperative programs. The structure of the Canadian Space Agency and its committees is outlined along with the process used for selecting research projects. The lack of Canadian launch capability has strongly driven Canada to international collaboration in which launch costs are shared. Canada is presently participating in eight programs which utilize free-flying satellites and which include Canadian contribution of space-qualified hardware in exchange for the data generated by the satellites. Collaboration with NASA occurs in shuttle projects and in the multinational Space Station Freedom. Author (CISTI)

N93-21072# Canadian Space Agency, Ottawa (Ontario).
SPACE STATION USER DEVELOPMENT PROGRAM: FUTURE PROSPECTS
R. G. Wilkinson *In its* Spacebound 1991 1991 p 9-14 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

The Canadian Space Agency's User Development Program (UDP) was established to ensure that Canada would be in a position to exploit its share of resources of the international space station. Objectives of the UDP include fostering research and development excellence among space station users, developing space station demonstration experiments with emphasis on commercializable technologies, assisting in development of space station hardware, and providing opportunities to access microgravity on a regular basis. At present, the scope of the UDP includes sciences and applications requiring a microgravity environment, but support for experiments in life sciences, earth observation, remote sensing, communications, and technology development is considered on a case-by-case basis. Subprograms of the UDP include the aircraft program, which provides regular access to a milligravity environment on three research aircraft: the rocket program, which provides access to microgravity conditions on the Canadian microgravity rocket, and a program supporting long-duration experiments in space. Author (CISTI)

N93-21073*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
LONG DURATION HUMAN EXPOSURE TO MICROGRAVITY Abstract Only
C. L. Huntoon *In* Canadian Space Agency, Spacebound 1991 1991 p 15 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

Looking toward the era of long duration manned spaceflight, questions remain regarding human adaptation to the weightless environment. In particular, bone calcium loss, cardiovascular deconditioning, and effects of radiation require further study. NASA has undertaken a series of experiments to increase the knowledge base of human adaptation to spaceflight. To date, results in the area of cardiovascular deconditioning countermeasures are the furthest advanced. The results from the upcoming SLS-1 mission will enhance knowledge in all areas. With continued research, there is every confidence that astronauts will be able to be kept healthy for long periods of time. Author (CISTI)

N93-21074# Canadian Space Agency, Ottawa (Ontario).
SPACE LIFE SCIENCES OVERVIEW c51
Alan Mortimer *In its* Spacebound 1991 1991 p 16-17 (For primary document see N93-21070 07-12)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

The Canadian Space Agency's Space Life Sciences program is reviewed. Collaborative programs with NASA have led to participation in the SLS-1 mission (neurovestibular physiology, cardiology) and preparation of experiments for Spacehab-J (amphibian development), IML-2 (neurovestibular physiology, neuro-autonomic control), and middeck DSO's (height change, cerebral blood flow). The Aquatic Research Facility will be built and flown on an annual basis as part of the NASA Life Sciences Secondary Payload Program. Cooperative programs with the Soviet Union include formation of a Canada/USSR joint working group in space life sciences; research in radiation, metabolism, gravitational biology, and neurovestibular physiology with the Institute of Biomedical Problems in Moscow; and a significant radiation dosimetry technology program. Precursor experiments for a MIR spaceflight experiment in metabolic changes are planned, and two experiments will fly on the 1992 Biosatellite Mission. Author (CISTI)

N93-21075# Canadian Space Agency, Ottawa (Ontario).
MICROGRAVITY SCIENCE ACTIVITIES IN CANADA **c29**
M. Z. Saghir *In its* Spacebound 1991 1991 p 18-23 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

The Canadian Space Agency's User Development Program (UDP) was formed to prepare Canadian scientists and engineers for the use of the facilities of NASA's Space Station Freedom program. The main emphasis of the UDP has been in the areas of materials and fluid sciences in microgravity environments, with provision of opportunities to perform microgravity experiments in aircraft and rockets. Current UDP programs in the following areas of research are summarized: metals and alloys; glasses; composite materials; crystal growth from melts, solutions, and biological materials; combustion; fluid physics; laser material processing; and hardware development. Four experiments accepted for flight on the first Canadian microgravity rocket program are also described. Author (CISTI)

N93-21076# Canadian Space Agency, Ottawa (Ontario).
UDP SPONSORED OPPORTUNITIES FOR MICROGRAVITY ENVIRONMENT **c29**
J. E. Fisher *In its* Spacebound 1991 1991 p 24-28 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

The Canadian Space Agency's User Development Program (UDP) provides researchers with access to microgravity environments. The main characteristics of the facilities available through UDP for microgravity research are described. These include drop tubes and towers, aircraft for parabolic flights, balloon-dropped payloads, rockets, the space shuttle, space stations, and orbiting payloads. Most of these facilities are shared with the space programs of other countries. Technical and logistical considerations for the use of these facilities are outlined, such as length and quality of the microgravity, decelerations, cost factors, and lead times for experiments. Author (CISTI)

N93-21077# Canadian Astronautics Ltd., Ottawa (Ontario).
FLOAT ZONE PROCESSING OF GERMANIUM CRYSTALS ON THE KC-135 MICROGRAVITY AIRCRAFT **c29**
C. E. Norman *In* Canadian Space Agency, Spacebound 1991 1991 p 31-35 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

A unique radiant heated furnace system was developed to study float zone processing in one-gravity and microgravity conditions. The furnace system was successfully flown on the NASA KC-135 microgravity aircraft and used for processing high purity germanium crystals. The furnace has a toroidal elliptical ring electric heater for concentrating heat onto the sample surface. A camera and video monitor provide a high-resolution real-time image of the float zone during processing. Ultrasonic sensing of the float zone during processing yields information on the position, size, and shape of the melt. On-line digital signal processing interprets the ultrasonic signals to yield external and internal float zone lengths during an experiment, and this information is used to control the float zone. The results of the experiments showed that the furnace system could operate in the variable gravity environment of the aircraft, and that a germanium float zone could survive the hypergravity portions of the flight, allowing continuous float zone processing through many parabolas. The effects of gravity on the free surface shape, the liquid column height, the contact angle, and growth diameter of the germanium were clearly observed. Author (CISTI)

N93-21078# SED Systems, Inc., Saskatoon (Saskatchewan).
GEODE 2: MANUFACTURING LARGE AREA FORMAT CADMIUM-MERCURY-TELLURIDE CRYSTALS IN A MICROGRAVITY ENVIRONMENT. PRESSURE SENSOR PROOF OF CONCEPT **c76**
M. R. Gale and D. A. Beattie *In* Canadian Space Agency, Spacebound 1991 1991 p 36-41 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

In the GEODE 1 experiment, a semiconductor Cd-Hg telluride crystal was grown in the MASER1 sounding rocket. It was shown that bulk-quench Cd-Hg telluride crystallization in a microgravity environment results in a more homogeneous crystal structure than can be achieved terrestrially. In the GEODE 2 program, the wall thickness of the quartz ampoule containing the crystal will be reduced to improve the heat transfer characteristics during crystallization. Ampoule explosion must be prevented by active control of the pressure surrounding the weaker, thin-walled ampoule to match that inside the furnace. A prototype pressure sensor that uses the absorption of ultraviolet light by Hg vapor has been built and tested. Pressures from 4 to 40 atmospheres have been measured with a resolution better than 0.35 atmospheres over the entire range. The feasibility of the pressure measurement technique has been demonstrated, although some design improvements are required in order to make measurements more repeatable. Author (CISTI)

N93-21079# Guelph Univ. (Ontario). Dept. of Chemistry and Biochemistry.
ELECTROCHEMICAL DEPOSITION OF THIN FILM SEMICONDUCTORS IN MICROGRAVITY: A FEASIBILITY STUDY **c76**
Jesko A. vonWindheim, Shixing Weng, Henry Wynand, and Michael Cocivera *In* Canadian Space Agency, Spacebound 1991 1991 p 42-47 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

A computer controlled electrochemical system has been built which can be used to prepare thin film semiconductors in the microgravity environment provided by parabolic flights of the KC-135 aircraft. CdSe films have been prepared under a variety of electrochemical conditions at 1 gravity and have been studied with the objective of developing equipment and procedures that could be applied to the microgravity environment to test if crystallization can be induced. The experimental results at 1 gravity are presented with the understanding that they will be repeated on the KC-135. CdSe was electrodeposited on glass coated with In/Sn oxide that had been untreated or coated with Cd, Se, or Au, or on n-GaAs. Untreated and gold-coated In/Sn oxide proved to be good substrates for the microgravity study of the electrodeposition of CdSe films prepared in 40 cycles of 20 seconds on and 30-180 seconds off. In addition, single crystal n-GaAs has proven to be a very good substrate for this study because it permits scanning electron microscopy study of thinner films and presents the possibility of epitaxial growth. Author (CISTI)

N93-21080# Victoria Univ. (British Columbia). Dept. of Mechanical Engineering.
ON THE MODELLING OF THE DISSOLUTION AND LIQUID PHASE EPITAXIAL GROWTH PROCESSES IN A HORIZONTAL SANDWICH SYSTEM **c76**
S. Dost, S. Erbay, and H. A. Erbay *In* Canadian Space Agency, Spacebound 1991 1991 p 48-52 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

In a recent study by Sukegawa et al (1988), the effects of the gravitational field on the dissolution and epitaxial growth of silicon in an In-Si system were examined experimentally. In the experiments, a horizontal substrate - solution - substrate sandwich system was used under near isothermal conditions. Preliminary results are presented of the mathematical modelling of the liquid phase epitaxial growth and dissolution processes of Si in this

sandwich system. The governing equations and the associated boundary and interface conditions of the system under isothermal conditions are given for a simple 2-dimensional model. The numerical results for the concentration distribution and the dissolution depth agree qualitatively with those of the reported experiment. To eliminate the quantitative discrepancies, it is recommended to take into account the effects of the thermal field in the modelling. Author (CISTI)

N93-21081# Winnipeg Univ. (Manitoba).
DEFECT CHARACTERIZATION BY MEANS OF POSITRON ANNIHILATION **c72**
S. Dannefaer, T. Bretagnon, and D. Kerr *In* Canadian Space Agency, Spacebound 1991 1991 p 53-58 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

A general introduction to positron physics is presented as it applies to the majority of problems encountered in the investigation of defects in semiconductors and metals. In non-perfect materials, lattice defects can trap positrons and such defects will alter the annihilation rate. Models for trapping and the analysis of positron lifetime spectra are outlined. Typically, vacancy-type defects present in concentrations above 0.1 parts per million lead to measurable responses. Results of positron annihilation investigations in semiconductors are reviewed. Recent advances in the case of silicon coupled with electron paramagnetic resonance data have firmly established key parameters such as positron lifetimes associated with various vacancy clusters and positron trapping cross sections for different charge states of vacancies. Collections of the most important results for Si, GaAs, and InP are presented. Author (CISTI)

N93-21082# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
DEVELOPMENT OF A KNUDSEN CELL FOR MOLECULAR BEAM EPITAXIAL GROWTH OF GaAs FILMS IN THE MICROGRAVITY ENVIRONMENT Abstract Only **c76**
W. D. Morison *In* Canadian Space Agency, Spacebound 1991 1991 p 59 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

A Knudsen cell for gallium deposition in an on-orbit molecular beam epitaxy laboratory is under development. This sub-component of a major NASA system is based upon ground-based designs; however, it incorporates several features which address some of the problems associated with the microgravity environment. The paper highlights the hardware development with use of video footage from the recent KC-135 flight and includes some analytical considerations. Author (CISTI)

N93-21083# Thomson and Nielsen Electronics, Ottawa (Ontario).
DIRECT-READING DOSIMETERS FOR SPACE LIFE SCIENCE EXPERIMENTS **c35**
I. Thomson and G. Mackay *In* Canadian Space Agency, Spacebound 1991 1991 p 63-68 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

Future space missions will require more detailed knowledge of radiation effects on electronics and humans. The longer the flight duration, the greater the potential hazard, as is shown in an overview of space radiation issues. Space radiation is very different from radiation of concern in terrestrial applications; not only is the physical nature of the radiation different, but its temporal and spatial variations add another dimension of complexity. It is very important to be able to measure space radiation with real time electronic devices which are small and can measure the different types of space radiation and warn of dangerously high levels. New, direct-reading electronic radiation monitoring techniques are described along with their application to dosimetry in space. It is shown that miniature silicon sensors can be used for the separate measurement of trapped high-energy protons and electrons, and cosmic rays. Two examples are used to illustrate the potential of these new technologies in life sciences and electronics applications. Author (CISTI)

N93-21084# Bubble Technology Industries, Inc., Chalk River (Ontario).
BUBBLE DETECTORS FOR THE MEASUREMENT OF SPACE RADIATION **c35**
H. Ing, K. Tremblay, A. Mortimer (Canadian Space Agency, Ottawa, Ontario.), E. E. Kovalev (Research Center of Space Craft Radiation Safety, Moscow, Russia.), V. E. Dudkin (Research Center of Space Craft Radiation Safety, Moscow, Russia.), A. M. Marenny (Research Center of Space Craft Radiation Safety, Moscow, Russia.), and N. A. Nefedov (Research Center of Space Craft Radiation Safety, Moscow, Russia.) *In* Canadian Space Agency, Spacebound 1991 1991 p 69-71 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

In a collaborative Canadian-Soviet research project, the bubble detector has been studied as a means for measuring radiation in space. Bubble detectors were flown in the Biocosmos 2044 satellite in 1989 in order to characterize the neutron radiation field during the mission. The detectors provided neutron dose measurements that were consistent with earlier work. These successes have led to a new series of experiments to map the neutron doses for orbits of various parameters. These experiments are being conducted in Cosmos satellites, which are not temperature controlled. Special temperature compensated bubble detectors have been designed for these missions. Future missions will involve much longer stays in space and in more hostile radiation environments. In tests of bubble detector response using high energy accelerators, the detectors were insensitive to the linear energy transfer from direct ionization. However, bubbles were observed after exposure to high energy ions. It was suggested that some of the bubbles were produced via nuclear collisions with materials in the environment or in the detector. This indicates the potential of using the bubble detectors to mimic various types of biological damage caused by space radiation. Author (CISTI)

N93-21085# Health and Welfare Canada, Ottawa (Ontario).
THE DEVELOPMENT OF AN AUTOMATED CELL CULTURE SYSTEM FOR USE IN SPACE LIFE SCIENCE RESEARCH **c51**
J. McLean, R. Bradley, D. Brown (Ottawa Univ., Ontario.), D. Gibbons (Ottawa Univ., Ontario.), F. Johnson (Ottawa Univ., Ontario.), A. Mortimer (Canadian Space Agency, Ottawa, Ontario.), M. Goddard, F. Mandy, G. Frappier, and F. Ryan *In* Canadian Space Agency, Spacebound 1991 1991 p 72-73 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

A cell culture laboratory has been designed to provide support for the research biologist studying the effects of hostile environments such as space on the growth, viability, and physiological state of mammalian cells. The laboratory is a miniature, ruggedly constructed, cell incubator with the built-in capacity to measure and record, at programmed intervals, both the number and the size of cells in the incubation chamber. The cell detector comprises a charge coupled device camera and an objective lens which give a resolution of 2 microns. An image analyzer provides limited information on cell morphology and cell membrane topology. Physiological conditions are monitored within the culture chamber by miniature pH and temperature sensors. Radiation exposure is measured by passive detectors and active dosimeters. Author (CISTI)

N93-21086# Saskatchewan Univ., Saskatoon.
CRYSTALLIZATION OF A PROTEIN ABOARD THE US SPACE SHUTTLE FLIGHT STS-31 **c76**
Louis T. J. Delbaere, Margaret Vandonselaar, Lata Prasad, J. Wilson Quail, Lawrence J. DeLucas (Alabama Univ., Birmingham.), and Charles E. Bugg (Alabama Univ., Birmingham.) *In* Canadian Space Agency, Spacebound 1991 1991 p 74-75 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

A monoclonal antibody designated Je142 has been generated against a small bacterial protein, and the interaction of the antibody with this antigen is being studied. The method of x-ray crystallography is being used to study the structures of the Fab fragment (the antigen-binding portion of the antibody) and the Fab fragment - antigen complex. Microgravity conditions have been shown to produce better quality crystals than analogous crystals grown on earth, thereby providing an opportunity to obtain x-ray data of better resolution. The Je142 Fab fragment was selected for microgravity crystallization on the space shuttle mission STS-31. The crystallization procedure was largely based on the hanging drop vapor diffusion method. Protein and precipitant solutions are extruded onto a

syringe tip and the combined droplet equilibrates with a concentrated reservoir precipitant that is on an absorbent material which surrounds the droplet. Just before the shuttle leaves orbit, the drop is withdrawn into the syringe to minimize mechanical stress on any protein crystals in the droplet. Je142 Fab fragment crystals typically require 8-9 days to reach optimum size (1 mm in each direction). Author (CISTI)

N93-21087# Toronto Univ. (Ontario). Thermodynamics and Kinetics Lab.

STABILITY OF THE FLUID-FLUID INTERPHASE IN ROTATING SYSTEMS SUBJECTED TO DIFFERENT GRAVITATIONAL INTENSITIES **c34**

J. A. Wade, D. Yee, and C. A. Ward *In* Canadian Space Agency, Spacebound 1991 1991 p 79-84 (For primary document see N93-21070 07-12)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

When an isothermal, constant volume, constant mass system containing two fluid phases is rotated in the absence of gravity, the lighter phase adopts a position on the axis of rotation. As the rate of rotation increases, the phase becomes elongated along its axis. If a gravitational field is applied in a direction perpendicular to the axis of rotation, depending on the field intensity, the rate of rotation and the system parameters, the lighter phase can become unstable and break into several smaller volumes. An experimental study of the stability of both the liquid-liquid and liquid-vapor phases of such a system was carried out at elevated, normal, and reduced gravitational intensities during parabolic flights in a KC-135 aircraft. It was found that for a given set of system parameters and gravitational intensity, there is a limiting value of the rotation rate at which the interphase will remain stable. Conversely, for a given rotation rate, there is a limiting gravitational intensity at which the interphase remains stable. From a simple force balance and ideal fluid theory, the experimental results are found to indicate that the difference in velocity of the fluid between the top and bottom of the lighter phase at breakup is a constant for a given system. Author (CISTI)

N93-21088# Brussels Univ. (Belgium).

PREPARATION RESULTS FOR A MARANGONI-BENARD EXPERIMENT WITH SORET EFFECT UNDER MICROGRAVITY CONDITIONS **c29**

S. VanVaerenbergh, P. Colinet, P. Georis, and J. C. Legros *In* Canadian Space Agency, Spacebound 1991 1991 p 85-90 (For primary document see N93-21070 07-12)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

Theoretical results on an investigation of Marangoni Benard instabilities in a binary mixture are presented. The concentration gradient is induced via Soret effect by a temperature difference applied across the layer. The stability of the resulting solutal nonlinear transient states are analyzed in terms of normal modes. The critical thermal Marangoni number is presented as a function of a Marangoni separation factor and of the different quasi stationary reference states. When the separation factor is negative, oscillatory instability will appear for a positive value of the Marangoni number close to the one corresponding to a pure fluid. The results are illustrated with an organic mixture in which oscillatory instability is expected to be observed under microgravity conditions. Author (CISTI)

N93-21089# Canadian Space Agency, Ottawa (Ontario).

ISOPYCNIC SYSTEMS AS MODELS FOR THE BEHAVIOR OF LIQUIDS IN A MICROGRAVITY ENVIRONMENT **c34**

Francois Quirion *In its* Spacebound 1991 1991 p 91-95 (For primary document see N93-21070 07-12)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

The water - methanol - benzene system at 25 C was used to simulate the behavior of two immiscible liquids in a container subjected to varying levels of gravitational force and interfacial tension. The effect of interfacial tension was investigated via the addition of surfactants (cetyl trimethyl ammonium bromide, sodium dodecyl sulfate, and Pluronic P-85). As expected, it was found that the wetting properties of the liquids towards the wall of the container strongly affect their behavior in the absence of gravity. Observations are made relating to the encapsulation of one fluid phase into another. These observations led to the development of a mathematical model that can predict the level of gravity necessary for the occurrence of encapsulation in a particular system. The model predicts that encapsulation can occur at density differences which are not zero and that there is a critical contact angle required for the encapsulation of a given fluid phase into another. Author (CISTI)

N93-21090# British Columbia Univ., Vancouver. Dept. of Mechanical Engineering.

GAS BUBBLE GENERATION IN LOW GRAVITY **c29**

Z. Abdullah, M. Salcudean, and M. Savage *In* Canadian Space Agency, Spacebound 1991 1991 p 96-10 (For primary document see N93-21070 07-12)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

A technique is described for generating gas bubbles of controllable sizes in low gravity environments. The method consists of gas injection through a vibrating injector mechanism. The gas bubbles detach primarily due to shear stresses generated by the injector motion. Experiments were carried out in the low gravity environment aboard a T-33 aircraft flying parabolic trajectories. Bubble formation and detachment in low gravity were recorded on video tape as a function of other experimental parameters. A bubble detachment model including the drag and surface tension forces was developed to predict the bubble diameters. Good agreement is obtained between the predictions and the experimental data when the buoyancy effects are small. Author (CISTI)

N93-21091# University of Western Ontario, London.

DYNAMICS OF SESSILE DROPLETS DISTORTION AND DISRUPTION BY ELECTRIC FIELD IN MICROGRAVITY CONDITIONS **c29**

I. I. Inculet, K. Adamiak, H. Rasmussen, K. Abdella, and T. E. Base *In* Canadian Space Agency, Spacebound 1991 1991 p 101-106 (For primary document see N93-21070 07-12)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

The evolution of a sessile droplet of water under an electric field was investigated in microgravity experiments conducted under parabolic flight. The water droplet was generated and placed on the surface of one electrode between two parallel plane electrodes. The evolution of each experimental droplet was recorded on high speed film. A simplified mathematical model for droplet behavior was also developed. The films show the full process of droplet deformation and breakup for different sizes of droplet and different values of the electric field intensity. When gravity is negligible and no electric field is present, the water forms a spherical drop. In an electric field, the droplet is distorted and in a strong field, two major stages may be distinguished. In the initial stage, the droplet is elongated following the electric field direction. Then a Taylor cone is formed and the droplet starts to eject very fine droplets from the cone tip. This is followed by oscillations of steady frequency and breaking caused by vibrations leads to disintegration of the droplet. Author (CISTI)

N93-21092# British Columbia Univ., Vancouver. Dept. of Pathology.

ORDERING OF AGGREGATING PARTICLE SUSPENSIONS UNDERGOING SIMPLE SHEAR **c34**

D. E. Brooks, A. Olal, and M. Bell *In* Canadian Space Agency, Spacebound 1991 1991 p 107-111 (For primary document see N93-21070 07-12)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

The reduced gravity environment offers a considerable advantage for the study of suspensions of aggregating particles, since no significant sedimentation effects should be present. A concentric cylinder shearing device was constructed and used to study monodisperse polystyrene latex suspensions. In order to reduce the sedimentation rate of the aggregates to allow their formation to be studied, the NaCl suspending medium was made about equal in density to that of the latex by setting the NaCl concentration to 1.44 moles per liter. When sheared in Couette flow, an ordering effect occurs at shear rates of a few inverse seconds and particle concentrations of under 1 volume percent. The system is initially cloudy and the particles randomly dispersed. As shearing is continued, small aggregates begin to form and continue to grow. The visible aggregates begin to arrange themselves into a regular, 2-dimensional, roughly rectangular lattice which gradually degrades as the aggregates sediment. The ordered lines become more regular as shear rate is increased. Mean aggregate

area decreases with increasing shear rate. The time for the appearance of the structure is inversely proportional to the shear rate and to the latex concentration. Author (CISTI)

N93-21093# Laval Univ. (Quebec). Dept. of Physics.
AGGLOMERATION OF FRACTALS IN SIMULATED REDUCED GRAVITY **c29**
R. J. Slobodrian, M. Cossette, B. Larouche, L. Potvin, and C. Rioux *In* Canadian Space Agency, Spacebound 1991 1991 p 112-117 In FRENCH (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

Ideal conditions for the formation of fractal agglomerates are found in a weightless environment. It has been found possible to produce relatively large fractals in conditions of simulated reduced gravity. Two methods of agglomerate production have been developed, based on the example of snowflake formation. One method consists of producing metallic vapors and allowing their condensation in a high density inert gas. Agglomerates of aluminum and other metals were successfully produced in the laboratory in a krypton gas atmosphere. The other method involves using fine powders in a liquid, where the settling is slow and agglomeration is favored. Agglomerates visible to the naked eye were formed with this method, using metal powders and carbon tetrachloride. The fractal nature of the agglomerates has been demonstrated by image analysis. The second method is simpler than the first and is readily adaptable to microgravity studies on board such aircraft as the KC-135. Author (CISTI)

N93-21094# McGill Univ., Montreal (Quebec). Dept. of Mechanical Engineering.
MICROGRAVITY COMBUSTION OF DUST CLOUDS **c25**
J. H. S. Lee and R. Knystautas *In* Canadian Space Agency, Spacebound 1991 1991 p 118-122 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

In a gravity-free environment, the true underlying mechanisms of heterogeneous combustion can be isolated from the peripheral complications of the gravitational field. As part of a program geared toward the long-term goal of combustion experiments in space, flame propagation and quenching were studied in aluminum dust-air clouds. The dust was dispersed with a novel electrostatic levitation technique. An appropriate level of insulation was used to permit the current flux necessary for dust suspension but to inhibit arc formation. In gravity-free space, the insulation would not be needed since the electrostatic field could be turned off once the dust is suspended. A range of aluminum dusts of roughly globular shape was studied over a range of stoichiometries. The flame propagation was observed to be very laminar, unlike previous studies with convective dispersion in which sporadic burst-like propagation was the norm. The estimated flame thickness for aluminum dust-air mixtures was about 5 times larger than a typical gas flame in a methane-air mixture. Author (CISTI)

N93-21095# Saskatchewan Univ., Saskatoon. Dept. of Mechanical Engineering.
A VISUALIZATION STUDY OF THE DIFFUSION PROCESS BETWEEN TWO LIQUIDS OF DIFFERENT DENSITIES UNDER MICROGRAVITY CONDITIONS **c34**
J. Falk and K. Rezkallah *In* Canadian Space Agency, Spacebound 1991 1991 p 123-128 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

A microgravity experiment was conducted during flights of the NASA KC-135 aircraft to study how liquids of various densities mix in different gravitational fields. Several chambers, each containing two liquids of different densities separated from each other by a divider, were subjected to gravitational fields of about 1.8 g in the pull-up period of flight and about 0.02 g during the pushover period. During the latter period, the diffusion process was recorded on a video camera. The observations were later compared with those obtained under normal gravity conditions. Under microgravity conditions, the water/water and water/salt water tests showed no mixing. Tests with water/alcohol and water/anti freeze showed significant mixing at microgravity, indicating that the gravitational force at that stage, although small, is still not zero. Author (CISTI)

N93-21096# Toronto Univ. (Ontario). Dept. of Chemical Engineering.
QUENCHING OF A TUBE AND FILLING OF A VESSEL UNDER MICROGRAVITY **c34**
M. Kawaji, C. J. Westbye, and B. N. Antar (Tennessee Univ. Space Inst., Tullahoma.) *In* Canadian Space Agency, Spacebound 1991 1991 p 129-134 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

A series of quenching experiments was conducted to investigate two-phase flow and convective boiling heat transfer phenomena which occur during rapid cooling and quenching of a hot quartz tube under microgravity aboard the NASA KC-135 aircraft. Long, continuous, and thick filaments and large droplets of liquid were seen to flow in the middle of the tube, unable to rewet the tube wall. The heat transfer rates were much lower than in 1 gravity under similar operating conditions and quenching was also significantly delayed. At the same time, the behavior of a liquid-vapor mixture during filling of an initially voided vessel was qualitatively studied using the same experimental apparatus. In filling the vessel under adiabatic conditions, the liquid was observed to flow along the wall and rarely detach from it. The core of the vessel was primarily voided and no significant masses of liquid were observed to float freely within the vessel. Author (CISTI)

N93-21097# Dalhousie Univ., Halifax (Nova Scotia). Dept. of Biology.
HOW DO ZOOPLANKTON FEED? A CRITICAL MICROGRAVITY EXPERIMENT **c51**
Daniel L. Jackson, Scott M. Gallager, and Ronald K. ODor *In* Canadian Space Agency, Spacebound 1991 1991 p 137-140 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

A series of experiments is proposed to improve understanding of how zooplankton capture phytoplankton. A summary of recent research on possible feeding mechanisms is presented, discussing the effects of such factors as gravity, cilia movements, and hydrodynamics. It is suggested that by manipulating gravity, direct effects should be seen on the prey encounter rate, capture efficiency of prey, and larval growth. One set of experiments would be conducted in parabolic flight and observations of swimming pattern, geometry, and behavior of scallop larvae would be compared at 1 gravity and at zero gravity. A longer duration study is also proposed for an experiment in the Canadian Space Agency's Aquatic Research Facility aboard the NASA shuttle. The effects of microgravity on feeding success, growth, and biogenic crystal precipitation in the larval shell would be assessed. These studies should provide missing elements for a comprehensive model of zooplanktonic feeding. Author (CISTI)

N93-21098# British Columbia Univ., Vancouver. Dept. of Oceanography and Zoology.
GRAVITY AS A FACTOR IN THE ORIENTATION AND VERTICAL MIGRATION OF MARINE ZOOPLANKTON **c51**
A. G. Lewis and J. Powlik *In* Canadian Space Agency, Spacebound 1991 1991 p 141-145 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

The proposed Aquatic Research Facility of the Canadian Space Agency offers a chance to isolate, at least partially, the effects of gravity from other factors that affect vertical migration in plankton and near-benthic organisms. It is proposed that zooplankton and near-benthic crustaceans orient with respect to the Earth's gravitational field, and a series of experiments is proposed to test this hypothesis in microgravity conditions in the Aquatic Research Facility aboard the NASA shuttle. The test organism will be the supralittoral copepod Tigriopus californicus. Laboratory work will provide background details such as the response of T. californicus to a surface during its 12-stage life cycle. The copepods will be subjected in the shuttle to static (microgravity) and centrifuge (1-gravity) conditions. Video images of the specimens will be recorded and analysis of the images will enable evaluation of the surface preferences of the organisms, their orientation, and feeding habits. Orientation under microgravity conditions, combined with the surface associations, will be used to suggest whether T. californicus actively uses gravity to orient towards a surface. Author (CISTI)

N93-21099*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

STUDYING THE EFFECTS OF MICROGRAVITY ON LOWER VERTEBRATE DEVELOPMENT AND BEHAVIOR Progress Report c51

Richard J. Wassersug (Dalhousie Univ., Halifax, Nova Scotia.), Scott Pronych (Dalhousie Univ., Halifax, Nova Scotia.), and Kenneth A. Souza *In* Canadian Space Agency, Spacebound 1991 1991 p 146-150 (For primary document see N93-21070 07-12)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

Lower vertebrates have been used in space research for at least 3 decades, and have a number of advantages such as the ability to be maintained safely in space conditions, high development rates, easy observability, and small size. Several major investigations with lower vertebrates are in the flight queue in various countries, and some of this research with amphibians that has Canadian Space Agency sponsorship is reviewed. In connection with NASA's frog embryology experiment, Canadian scientists will conduct postflight experiments on live tadpoles brought back from space to determine whether larvae that develop from these embryos are behaviorally normal. Swimming kinematics in particular will be examined, since a distinctive looping behavior of Xenopus tadpoles under microgravity has been noted. A collaborative study with the Institute of Biomedical Problems in Moscow is designed to elucidate the relationship between buoyancy regulation and lung development in tadpoles, and is scheduled to fly on a Biocosmos satellite in 1992. Author (CISTI)

N93-21100# MPB Technologies, Inc., Sainte-Anne-de-Bellevue (Quebec).

DEVELOPMENT OF THE AQUATIC RESEARCH FACILITY c14

M. Olivier, S. Simard, A. Laferriere, B. P. Tailor, J. Blezius, and N. Paquin *In* Canadian Space Agency, Spacebound 1991 1991 p 151-157 (For primary document see N93-21070 07-12)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

The Aquatic Research Facility (ARF) is a modular, multi-user facility for aquatic life science experiments in microgravity. It is being developed under a joint agreement between the Canadian Space Agency and NASA. The ARF is designed to be installed in the space shuttle mid-deck area. Generic features of the ARF include an environmental chamber with active cooling, uniform illumination in the visible range, microgravity capability and a centrifuge for 1-gravity capability, data acquisition and control electronics, high resolution video cameras with light source and imaging optics, and specimen storage and fixation capability. The facility is designed to accommodate a total of 12 standard containers into which user-specified specimen chambers, each having up to 100 ml volume, are installed. The design philosophy based on versatility and adaptability is described and the system specifications are summarized. Examples of possible experiments are also presented. Author (CISTI)

N93-21101# Canadian Space Agency, Ottawa (Ontario).

CANADIAN MICROGRAVITY EXPERIMENTS FLOWN IN 1990-1991 c29

Glen S. Campbell, Lawrence Vezina, and John Aitken (National Research Council of Canada, Ottawa, Ontario.) *In its* Spacebound 1991 1991 p 161-168 (For primary document see N93-21070 07-12)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

An overview is given of Canadian microgravity experiments flown during April 1990 to March 1991. The NASA KC-135 aircraft was used for 29 experiments in three flights, and the National Research Council of Canada T-33 aircraft was used for six experiments. The facilities on each aircraft are described and the individual experiments are summarized. These included testing of isolation mounts; investigation of the effects of microgravity on various aspects of human physiology and behavior; preparation of ceramics, metals, and foams; laser drilling and welding; behavior of tadpoles; and fluid physics studies, including bubble stability, two-phase flow, heat transfer, and droplet breakup. Author (CISTI)

N93-21102# Orbitics, Paris (France).

EXPERIMENTS ABOARD THE CARAVELLE FOR THE 3 ESA CAMPAIGNS IN 1990 c29

Christophe Cornuejols *In* Canadian Space Agency, Spacebound 1991 1991 p 169-173 (For primary document see N93-21070 07-12)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

The European Space Agency (ESA) is doing three to four parabolic flight campaigns per year for the purposes of basic scientific research, preparing experiments to be performed later in orbit, or checking the validity of technical concepts for space hardware. The experiments are conducted aboard a modified Caravelle aircraft which performs microgravity parabolas of 20-22 seconds. A typical flight has 30-36 parabolas and six to eight experiments. Representative ESA experiments during these flights in 1990 are reviewed in the areas of fluid physics (Marangoni convection, phenomenology of fluid zones, liquid transfer, forces exerted by liquids on tanks), materials science (behavior of critical fluids, liquid-phase sintering of tungsten composites), liquid droplet burning, human physiology (vestibular nystagmus, otolith response, spatial orientation, blood pressure and heart rate, fluid shifts), and microgravity technology. Author (CISTI)

N93-21103# Bristol Aerospace Ltd., Winnipeg (Manitoba).

CSAR-1: THE FIRST CANADIAN MICROGRAVITY SOUNDING ROCKET FLIGHT c29

Kenneth R. Walsh and Corey Mack *In* Canadian Space Agency, Spacebound 1991 1991 p 174-180 (For primary document see N93-21070 07-12)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

The Canadian Microgravity Rocket Program has been established by the Canadian Space Agency to provide a low cost, high quality microgravity environment to researchers interested in investigating phenomena and processes that are masked by gravity. An ongoing series of rocket flight opportunities, designated CSAR, is planned in order to support these scientific investigations. The Black Brant family of rockets will be used to carry the payloads into space. In the first flight (CSAR-1), a total payload of about 1058 pounds will be carried to a height of about 240 km, providing experimenters with a microgravity duration of about 360 seconds. CSAR system design is based on using modules for individual experiments combined with standard modules common to every mission. The microgravity payload is recovered so that samples and experiments can undergo post-flight evaluation and so that as many modules as possible can be reused, thereby reducing mission turnaround time and costs. The CSAR-1 mission will include experiments on the coarsening kinetics of immiscible alloys, the formation of silicon carbide whiskers, particle growth and dispersion strengthening in metal matrix composites, processing of glasses, and the surface chemical degradation of high strength polymers. Author (CISTI)

N93-21104# Space Technology Corp., Kearneysville, WV.

INTERNATIONAL AND COMMERCIAL SUB-ORBITAL PROGRAM FOR MICROGRAVITY RESEARCH Abstract Only c29

J. R. Williams *In* Canadian Space Agency, Spacebound 1991 1991 p 181 (For primary document see N93-21070 07-12)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

The most serious impediment to microgravity research is the lack of frequent flight opportunities. This is exacerbated by the lack of appropriate experiment hardware. The capabilities of a series of flight qualified experiment modules, and the process whereby investigators can acquire their use and gain access to the low-gravity environment for six to fifteen minutes are described. Author (CISTI)

N93-21105# Space Industries, Inc., Webster, TX.

THE WAKESHIELD FACILITY: FREE FLYER AND COMMERCIAL EXPERIMENT TRANSPORTER PROGRAMS c14

Olav Smistad *In* Canadian Space Agency, Spacebound 1991 1991 p 182-188 (For primary document see N93-21070 07-12)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

Space Industries Incorporated (SII) has developed certain facilities as part of an infrastructure for the continuing commercialization of space. Two of these are described. The Wakeshield Facility Free Flyer (WSF-FF) is a circular shield, 12 feet in diameter, designed to deflect stray atoms and molecules found in orbit and thereby create an ultrahigh vacuum in its wake. Elements of the WSF-FF include the shield and its associated control and communication systems, a cross-bay carrier for mounting containers,

and smart canisters each having command and communications capability. These canisters can be used for experiments or processes, such as materials research and processing, which require a high vacuum and microgravity conditions. The COMET free flyer aims to provide a low cost system for launching and recovering orbiting payloads. COMET consists of a modular recovery system and reentry vehicle, a service module for providing on-orbit resources for the recovery system payloads, and a launch vehicle (the EER/SSD Conestoga). The COMET is intended for long duration microgravity materials processing, life sciences, and materials exposure experiments. The first launch is scheduled for September 1992. Both the WSF-FF and COMET programs are structured to provide commercial, low-cost, reliable, and routine access to the microgravity environment. Author (CISTI)

N93-21106# Electrofuels Mfg. Co., Toronto (Ontario).
STUDIES OF DISPERSED PHASE SYSTEMS: OSTWALD RIPENING AND METAL MATRIX COMPOSITES **c24**
C. B. Alcock, A. McLean, J. Butler, S. Das Gupta, J. Jacobs, and A. Majumdar *In* Canadian Space Agency, Spacebound 1991 1991 p 191-194 Prepared in cooperation with Toronto Univ., Ontario (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

Studies of Ostwald ripening in solid-liquid and liquid-liquid systems have been inconclusive, primarily due to the effect of gravity on the particulate phase. Microgravity experiments provide an excellent opportunity to overcome such difficulties. Experiments were designed to be performed under microgravity conditions so that segregation of whiskers and particles in metal matrix composites could be avoided, resulting in materials with vastly improved properties compared to those produced in terrestrial conditions. Ground-based experiments on eutectic salt mixtures and Al/SiC or Al/TiB2 systems were conducted to obtain sufficient data for comparison against the results of space experiments. Ostwald ripening studies of the eutectic salts indicated that even for short time durations, there was a shift in the original particle size distribution curve as smaller particles disappeared rapidly. Long-duration experiments seem to indicate that the coarsening mechanism is diffusion controlled. Dispersion strengthened metal matrix composites could not be produced and liquid-liquid salt systems could not be studied due to particle segregation under gravity. A 32-chamber experimental module has been built for use in the subsequent microgravity investigations. Author (CISTI)

N93-21107# Ceramics Kingston Ceramiques, Inc. (Ontario).
ELUCIDATION OF THE ROLE OF GRAVITY AND GRAVITY DRIVEN CONVECTION IN THE FORMATION OF SILICON CARBIDE/SILICON NITRIDE WHISKERS **c76**
S. N. Kumar, D. Mallette, A. Pant, and R. Sood *In* Canadian Space Agency, Spacebound 1991 1991 p 195-199 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

Microgravity experiments on the role of gravity in the growth of silicon carbide and silicon nitride whiskers are to be conducted in a sounding rocket. A rocket qualified high temperature furnace has been designed and developed for these experiments. The vapor solid liquid mechanism of crystal growth is explained and the scientific issues to be addressed in the microgravity experiments are discussed. These are the role of droplet size in determining the whisker diameter, effects of flow field fluctuations caused by gravity-driven and Marangoni convection, and the role of multiple nuclei. The furnace consists of a graphite insulation module surrounding a hot zone 3 inches in diameter and 4 inches long, all enclosed in a vacuum tight shell. The furnace is designed to reach an operating temperature of over 1700 C in under a minute, to sustain this temperature for the 5-6 minute duration of the microgravity period, and to cool down to below reaction temperature before the microgravity period is over. The furnace is battery powered and is energized by off-board batteries to an intermediate temperature below the reaction temperature in order to minimize the power requirement from on-board batteries. Ground tests have demonstrated the satisfactory capabilities of the furnace system. Author (CISTI)

N93-21108# Fiberglas Canada, Inc., Sarnia (Ontario).
POLYMER FOAM CELL GROWTH IN MICROGRAVITY **c29**
Margaret M. Curtin, Frank S. Tyler, and David L. Wilkinson *In* Canadian Space Agency, Spacebound 1991 1991 p 200-206 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

Experiments were conducted during parabolic flights of the NASA KC-135 to study cell morphology, size, spatial distribution, and mechanical properties in the production of foams from phenolic resins. A special apparatus was designed to contain the resin and catalyst components, mix these components at a fixed volume ratio, and subsequently dispense the mixture into a chamber. To maximize foaming time in microgravity, the dispensing of the mixture into the chamber was carefully timed to begin when the microgravity period started. Microgravity foams consistently occupied less volume than the control (ground) samples, with densities being higher. Cell size of microgravity foams was significantly greater than that of ground-produced foams. Cell size distributions within morphology clusters were also narrower. The observations suggest that the absence of gravitational drainage effectively increases the free energy requirement of the foaming system, thus affecting many aspects of foaming dynamics including efficiency of cell nucleation and degree of coalescence.
Author (CISTI)

N93-21109# Saskatchewan Univ., Saskatoon. Dept. of Mechanical Engineering.
AN EXPERIMENT ON PRODUCING FOAM METALS IN A MICROGRAVITY ENVIRONMENT ABOARD NASA KC-135 AIRCRAFT **c29**
Kamiel Rezkallah, Scott Huckerby, and Darren Mitchell *In* Canadian Space Agency, Spacebound 1991 1991 p 207-212 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

The microgravity environment offers unique possibilities for producing metal foams, since buoyancy effects are virtually eliminated. The behavior of bubble dispersion in the molten metal was studied in experiments conducted on the NASA KC-135. The experimental apparatus and the results obtained are described. Tin metal in varying tin/air ratios (from 90/10 to 30/70) was melted and a shaking mechanism was used to distribute gas throughout the molten metal. A non-uniform gas distribution was observed in the metal, with small voids randomly formed in the samples with high metal volumetric ratios, and large voids (mostly close to the sample container walls) with low metal volumetric ratios. It was also found that with the high metal content in the sample containers, very small bubbles migrated in a trajectory which could perhaps be predicted using some particle tracking theories. This migration is attributed to small residual gravity forces creating a positive acceleration in the longitudinal direction of the aircraft. Author (CISTI)

N93-21110# British Columbia Univ., Vancouver. Dept. of Metals and Materials Engineering.
GAS BUBBLES IN LIQUID METALS **c29**
F. Weinberg and C. Mui *In* Canadian Space Agency, Spacebound 1991 1991 p 213-218 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

Experiments were conducted in microgravity conditions aboard the NASA KC-135 to examine the behavior of gas bubbles in liquid metals under low gravity conditions. Tests were carried out in cells of water and liquid tin both at 1 gravity and low gravity in which gas bubble generation was examined as a function of gas pressure. In low gravity, the number of bubbles progressively decreased and diameter increased until bubble generation effectively stopped. With liquid tin, which was sectioned and polished after solidifying, no small bubbles were detected. It was concluded that bubbles did not enter the liquid metal but flowed along the cell walls and escaped. In subsequent experiments, the bubbles entered the liquid if the metal wet the cell wall. Other aspects of the bubble behavior problem were investigated, including the pushing of bubbles by particles during melt soldification, bubbles sticking to container walls, induced flows in liquid metals, and chemical reactions at gas bubble/liquid interfaces.
Author (CISTI)

N93-21111# Defence and Civil Inst. of Environmental Medicine, Toronto (Ontario).

EYE MOVEMENTS UNDER ALTERED GRAVITOINERTIAL FORCES **c29**

Bob S. K. Cheung, Ken E. Money (York Univ., Ontario.), and Ian P. Howard *In* Canadian Space Agency, Spacebound 1991 1991 p 221-223 (For primary document see N93-21070 07-12)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

A study was conducted under microgravity conditions in parabolic flight in order to examine simultaneously torsional, vertical, and horizontal eye movements under two visual conditions: visual fixation on a stationary light and while looking at an imaginary target in darkness. Four of the seven experimental subjects showed similar characteristics of eye displacements in the three planes. There was evidence of torsional eye movements in response to the imposition of altered gravitational forces, and there was little evidence of vertical eye movements. Without visual fixation on the light, vertical nystagmus with the slow phase directed upwards was observed during transition from hypergravity to microgravity. No significant sustained horizontal nystagmus was observed in any of the subjects under either visual condition. The vertical nystagmus observed can be attributed to a change of otolithic stimuli along the subject's z axis (towards the floor of the aircraft). Author (CISTI)

N93-21112# Canadian Space Agency, Ottawa (Ontario).

CEREBRAL AUTOREGULATION IN MICROGRAVITY **c52**

R. Aaslid, R. L. Bondar, M. S. Kassam (Ryerson Polytechnical Inst., Toronto, Ontario.), F. Stein (Ryerson Polytechnical Inst., Toronto, Ontario.), and P. Dunphy (Ryerson Polytechnical Inst., Toronto, Ontario.) *In its* Spacebound 1991 1991 p 224-227 (For primary document see N93-21070 07-12)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

Experiments were conducted aboard the NASA KC-135 parabolic flight laboratory to assess the cerebral autoregulatory function after transition to microgravity. Cerebral blood flow velocities were measured by transcranial Doppler methods. Typical response of blood flow velocity was an increase just after transition to microgravity, followed by a return to the pre-microgravity value. A simple mathematical model was developed to facilitate the analysis of autoregulation dynamics. The increase was predicted by the increase in arterial blood pressure. The decrease in the later microgravity phase could only be predicted by a model incorporating autoregulation. The cerebral autoregulation seemed to have the same dynamic response characteristics as in normal subjects tested under normal gravity in the supine position. Author (CISTI)

N93-21113# York Univ. (Ontario). Inst. for Space and Terrestrial Science.

AIMED ARM MOVEMENTS UNDER CHANGED GRAVITY Abstract Only **c54**

O. Bock, I. Howard, K. Money, and K. Arnold *In* Canadian Space Agency, Spacebound 1991 1991 p 228 (For primary document see N93-21070 07-12)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

The accuracy of aimed arm movements under normal gravity and during the hyper- and micro-gravity episodes of KC-135 parabolic flight were analyzed. Five human subjects pointed at the reflected images of visual targets in a frontal plane 33 cm ahead, while vision of their arm was prevented. The final position of the pointing finger was recorded on impact with a digitizing pad. Compared with the normal gravity baseline, subjects pointed about 44 mm higher in microgravity and about 25 mm higher in hypergravity. The results were the same if subjects viewed the targets only during the normal gravity episode and pointed at the memorized target position during the changed gravity episode. This result implies that pointing performance under changed gravity is not due to visual mislocalization but rather to problems of motor control. The microgravity results are explained by assuming that the movements are preprogrammed and that programs appropriate on earth will yield upward deviations in microgravity. In hypergravity, it is postulated that the motor system reinterprets increased gravity as an additional weight acting on the arm under normal gravity. The resultant muscle forces will compensate properly for the increased gravity but overcompensate the arm's inertia. Author (CISTI)

N93-21114# Waterloo Univ. (Ontario). Dept. of Kinesiology.

RESPIRATORY RESPONSE TO VARYING DEGREES OF TILT AND LOWER BODY NEGATIVE PRESSURE **c52**

A. Blaber, M. Frazer, K. Shoemaker, and M. Sharratt *In* Canadian Space Agency, Spacebound 1991 1991 p 229-234 (For primary document see N93-21070 07-12)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

The effects of head up tilt (HUT) and head down tilt (HDT), as well as lower body negative pressure (LBNP), on ventilatory mechanics were studied. The results from three subjects are presented with measurements of functional residual capacity (FRC), intra-abdominal pressure (IAP), minute ventilation (MV), ventilatory frequency (f), and the relative changes in abdominal and chest movements during rest at 90 deg HUT to 6 deg HDT and 0 mmHg to -40 mmHg LBNP. Functional residual capacity and IAP decreased, and the relative proportion of chest movements increased, from HUT to HDT. Since LBNP is thought to mimic standing, it was predicted that with increased LBNP the ventilatory parameters would return to standing values. However, only FRC changed significantly in the direction of standing values. In two of the subjects, this increase in FRC was not seen until -40 mmHg, indicating that the conditions for going from 0 to -40 mmHg may not be enough to override the effects of being in the supine position on FRC. Changes occurred in IAP and chest contribution to breathing but varied from subject to subject. These results suggest differential effects of gravity (tilt) and suction (LBNP) on ventilatory mechanics as well as strategies employed by subjects to compensate for LBNP between 0 and -40 mmHg. Author (CISTI)

N93-21115# Aastra Aerospace, Inc., Downsview (Ontario).

MICROGRAVITY PROCESSING OF CERAMIC COMPOSITES **c29**

W. Kung, C. Rucker, and G. Shapiro *In* Canadian Space Agency, Spacebound 1991 1991 p 237-240 (For primary document see N93-21070 07-12)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

Sol-gel processing experiments were conducted in the low gravity environment provided by a T-33 aircraft. Two distinctly different types of second phase additions were studied: a liquid/particle system (alumina - SiC); and a liquid/liquid system (alumina - zirconia). Experimental procedures were found to gel the sols within the 30 seconds of low gravity provided during each parabola of the flight. Automated flight hardware was developed to perform the airborne experiments, and control experiments using the flight hardware were conducted in the laboratory. After each flight, the gelled samples were dried, bisqued, and sintered. Scanning electron microscopy analysis was conducted on both composite systems. Both the alumina/SiC and alumina/zirconia systems produced in low gravity demonstrated a higher degree of second phase homogeneity using both a second phase count density analysis on scanning electron micrographs and density measurements. Author (CISTI)

N93-21116# Martec Ltd., Halifax (Nova Scotia).

FINITE ELEMENT ANALYTICAL TECHNIQUES FOR CERAMIC PRODUCTION IN MICROGRAVITY-2 **c29**

F. Taheri and D. A. Crick (Advanced Materials Engineering Centre, Halifax, Nova Scotia.) *In* Canadian Space Agency, Spacebound 1991 1991 p 241-246 (For primary document see N93-21070 07-12)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

The finite element program ABAQUS is used to evaluate the residual stresses resulting from the sintering process on alumina ceramic. Two sintering methods were examined in the analysis, conventional and isothermal. The effect of microgravity was evaluated, based on the lack of natural convection in microgravity and the change in the initial porosity distribution resulting from slip casting rheology. Heat transfer finite element analysis was performed to evaluate the temperature distribution at each time element. Finite element stress analysis was then used to evaluate the stresses. The HYPOELASTIC option of the code was employed to characterize the transient behavior of the porous material. The influence of microgravity on both slip cast rheology and the sintering mechanism is

discussed. The lack of natural convection was found to play a distinct role only in the cool-down phase of isothermal sintering. The state of residual stress is much more pronounced for a geometry with more bulk than that with fairly thin overall thickness. Author (CISTI)

N93-21117# ORTECH International, Mississauga (Ontario).
THE PRODUCTION OF HIGH IRON GLASSES BY RST IN MICROGRAVITY Abstract Only **c29**
B. H. Fox and B. G. Sellars *In* Canadian Space Agency, Spacebound 1991 1991 p 247 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

A high iron glass was prepared by rapid solidification technology in a microgravity environment utilizing the parabolic flight of the KC-135 aircraft. This glass was used as a precursor for the production of barium hexaferrite material by a glass-ceramic fabrication route. The paper outlines the development and fabrication of the experimental equipment, discusses its use in microgravity, and presents preliminary results on the materials produced during the flight. Author (CISTI)

N93-21118# BM Hi-Tech, Inc., Collingwood (Ontario).
EFFECT OF GRAVITY ON PHASE SEPARATION AND CRYSTALLIZATION IN A HEAVY METAL FLUORIDE GLASS **c29**
S. Varma, S. E. Prasad, I. Murley, and T. A. Wheat (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario.) *In* Canadian Space Agency, Spacebound 1991 1991 p 248-252 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

It is believed that higher than expected transmission losses in fluoride glass optical fibers are due to the formation of microcrystallites during glass synthesis and forming. The large density difference between different constituents of the glass could lead to rapid phase separation and crystallization under gravity. The absence of gravity driven segregation in microgravity should help in minimizing such crystallization. In a preliminary investigation, thin filaments of ZBLAN metal fluoride glass were encapsulated in quartz ampoules and heat treated in the 300-500 C range for 20 seconds in microgravity, 1 gravity, and 2 gravities. The samples were analyzed using optical and scanning electron microscopy, energy dispersive x-ray analysis, and differential thermal analysis. The electron microscopy analysis revealed the presence of one or two crystallized phases in 2-gravity processed samples, depending on the heat treatment temperature. The samples processed in microgravity did not show any evidence of crystallization. Author (CISTI)

N93-21119# McMaster Univ., Hamilton (Ontario). Dept. of Materials Science and Engineering.
LIQUID/LIQUID PHASE SEPARATION AND CRYSTALLIZATION OF MATERIALS IN MICROGRAVITY ABOARD NASA KC-135 FLIGHTS Abstract Only **c29**
S. Johar and G. P. Johari *In* Canadian Space Agency, Spacebound 1991 1991 p 253 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

For experiments on liquid/liquid phase separation and crystallization during the 20-25 second periods of microgravity aboard KC-135 flights, an apparatus was designed to carry out heating and quenching of six vitrified solids simultaneously. This allowed observations to accumulate over a period of about 10 minutes of microgravity. A microstructural examination and a comparison with the results of similar experiments in 1 gravity was made. A variety of inorganic, metallic, and polymeric glasses was studied. The morphology of both the crystals formed and of the spinodally separated liquids in microgravity is found to differ remarkably from that formed in 1 gravity. In several cases, the crystals formed were a result of a spheroidal growth in microgravity, which was dendritic in 1 gravity, and crystallization of the liquid phase occurred after spinodal separation of the liquid into spherical regions. Several features of the microstructural aspects of these studies are described. Author (CISTI)

N93-21120# Manitoba Univ., Winnipeg. Metallurgical Sciences Lab.
GRAIN REFINEMENT OF Al-Cu-Ti ALLOYS IN MICROGRAVITY **c29**
J. R. Cahoon, K. N. Tandon, and M. C. Chaturvedi *In* Canadian Space Agency, Spacebound 1991 1991 p 257-260 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

There is evidence that for alloys where Ti is the only grain refining agent, the liquid-Al3Ti peritectic reaction is at least partially responsible for the grain refinement. If this is the case, then solidification in microgravity should have a significant effect on the grain refinement behavior since there are no convective currents to distribute the heterogeneous nucleant particles of Al3Ti throughout the melt. Therefore, grain refining experiments were conducted by solidifying Al-Cu-Ti alloys aboard the NASA KC-135 aircraft under conditions of 0 and 1.8 gravity. Small ingots of Al containing 4 weight percent Cu with and without Ti additions were melted and solidified on board the aircraft and later examined for grain size and structure. The results showed that the magnitude of gravity had no effect on the grain size and structure. The Al/4 percent Cu ingots solidified with a columnar structure of similar grain size and Al/4 percent Cu/0.2 percent Ti alloys solidified with an equiaxed structure of similar grain size irrespective of the magnitude of gravity. The results indicate that the peritectic reaction in Al-Ti alloys is not responsible for grain refinement. It is possible that small amounts of insoluble impurities such as TiC are responsible for the grain refining effect. Author (CISTI)

N93-21121# McGill Univ., Montreal (Quebec). Dept. of Mathematics and Statistics.
INTERFACIAL WAVE THEORY ON FORMATION OF DENDRITIC STRUCTURE IN BINARY ALLOY SYSTEM **c26**
Jian-Jun Xu *In* Canadian Space Agency, Spacebound 1991 1991 p 261-264 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

The global instability and pattern formation of microstructures are studied for the dendritic solidification of a dilute binary mixture. As an initial investigation, a pure thermodynamical system with isotropic surface tension is considered. The interfacial wave theory of solidification is extended from a pure substance to a binary system. For such a system, there also exists a special simple turning point which plays a crucial role for the pattern formation dynamics. Near this turning point and the leading edge of the dendrite tip, there exist the interactions of the interfacial waves; the propagation and interaction of travelling interfacial waves give rise to a global instability mechanism of the system called the global trapped wave (GTW) mechanism. The global GTW-mode solutions are derived along with the quantum condition for the eigenvalues and also the self-sustaining GTW-mode. The presence of the self-sustaining GTW-mode explains the origin and persistence of the pattern formation in the process of solidification. On the other hand, the global neutral stability condition of the GTW-mode yields the tip velocity of the dendrite. The dendritic pattern predicted by the theory is shown to resemble experimental results. Author (CISTI)

N93-21122# Queens Univ., Kingston (Ontario).
RIPENING OF IMMISCIBLE LIQUID DROPLETS IN MICROGRAVITY WITH CONSTRAINED MARANGONI DRIFT **c29**
S. Goodman and R. W. Smith *In* Canadian Space Agency, Spacebound 1991 1991 p 265-270 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

In order to investigate droplet growth phenomena in immiscible alloy systems, experiments are being performed with the binary system Al-In. The experiments are performed during the reduced gravity periods available in parabolic aircraft trajectories and sounding rocket flights. These experiments, as well as ground-based work, constitute the QUIMAL program (Queen's University Experiments in Immiscible Alloys). The aim of the program is to restrain Stokes flow as well as Marangoni convection in order to measure the rate of droplet growth due to Ostwald ripening alone. In order to restrain these forces, a small amount of Fe is added to the system. The addition of Fe results in, upon cooling, the nucleation of intermetallic FeAl3 blades prior to the separation of In droplets. Preliminary experiments aboard the NASA KC-135 have shown that 3 percent by weight of Fe is effective in reducing Marangoni drift. The results of all QUIMAL tests done to date are presented along with an overview of the experiment preparations and hardware design. Author (CISTI)

N93-21123# ThermaZone Engineering, Inc., Ottawa (Ontario).
CRYSTAL GROWTH THROUGH A COMPUTER CONTROLLED, EIGHT ZONE THERMAL GRADIENT FREEZE FURNACE **c76**
Michael R. Bishop *In* Canadian Space Agency, Spacebound 1991 1991 p 271-274 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

Multiple temperature zone gradient furnaces are well suited to investigate crystal growth processes, since they have a plurality of independently controlled temperature zones which can be programmed to process a wide variety of materials under specific growth rate and temperature gradient conditions. The ongoing design and operation of a low cost multiple zone gradient freeze furnace is described. An early version consisted of the furnace core made of threaded hollow alumina around which eight independent resistive wire elements were wound, along with a power supply and a control system. Performance of the furnace was tested using both zinc and tin samples with a variety of furnace operating characteristics. A number of problems were revealed such as the difficulty of maintaining high thermal gradients. A numerical modelling review of the design indicated that the most significant feature limiting performance was the air gap separating the alumina core from the ampoule containing the sample. To improve performance, several fundamental changes were made. The core was modified into a series of independent ceramic elements, and isolated air cooling paths for each zone were installed. The entire furnace assembly was cabinetized for stability and portability in preparation for testing in a low gravity environment. Author (CISTI)

N93-21124# Canadian Space Agency, Ottawa (Ontario).
ACCELERATION LEVELS ON THE KC-135 **c05**
Bjarni V. Tryggvason *In its* Spacebound 1991 1991 p 277-282 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

It is essential to have a sound appreciation of the actual acceleration levels, and specifically the level of departures from ideal free fall, in order to effectively design hardware and plan microgravity experiments in the NASA KC-135 aircraft. The general flight path for a typical KC-135 mission is described along with the acceleration conditions generally encountered. Examples of measured acceleration traces in the x, y, and z directions during the zero-gravity phase of flight are presented and the statistical character of the KC-135 acceleration levels is analyzed. An average time span for periods of under 0.05 gravities is estimated at about 19 seconds, in contrast to the 25 seconds of zero gravity typically reported in the literature. Departures from zero gravity on the order of 30 milligravities are to be expected and experiments on the aircraft must be viewed as statistical in nature, with results being interpreted statistically. Author (CISTI)

N93-21125# York Univ. (Ontario).
LASER WELDING OF PLASTICS UNDER LOW AND HIGH GRAVITY CONDITIONS **c29**
R. E. Mueller and W. W. Duley (Waterloo Univ., Ontario.) *In* Canadian Space Agency, Spacebound 1991 1991 p 283-288 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

Results are presented from a series of CO2 laser penetration welding experiments on polypropylene plastic sheets carried out under several gravity conditions. Welds were performed in low (up to 50 milligravities) and high (1600 +/- 200 milligravities) gravity conditions as provided on the NASA KC-135 aircraft. For comparison, welds were also made under normal 1-gravity conditions in three orientations relative to the gravity vector. Plastics were used to allow direct observation and recording of keyhole behavior with a low power (25-watt) laser compatible with the aircraft power supply. Differences in phenomenology between microgravity and terrestrial welding were examined, and attempts were made to separate gravitational and surface tension effects of the laser-material interaction. Insight was obtained into weld porosity problems caused by spiking and other gas entrainment mechanisms. The results show that stable penetration welding of plastics can be carried out in low gravity. The weld keyhole is narrower under low-gravity conditions and transverse spiking, which increases weld porosity, is more evident; weld depletion is reduced while better penetration is obtained for a given laser power. Weld strength appears unaffected by the change in gravity. Author (CISTI)

N93-21126# Ecole Polytechnique, Montreal (Quebec).
DISCUSSION OF THE OPTICAL EFFECTS CREATED BY A LASER SOURCE ON PARTICLES UNDER MICROGRAVITY [DISCUSSION DES EFFETS OPTIQUES CREES PAR UNE SOURCE LASER SUR DES PARTICULES EN MICROGRAVITE] **c36**
Jean-Marie Gagne and Francois Babin *In* Canadian Space Agency, Spacebound 1991 1991 p 289-294 In FRENCH (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

The photomechanical effects created when light from a laser is focused on the surface of a dielectric non-absorbent liquid are discussed, in particular for microgravity conditions. In order to determine the role of gravity on the amplitude of the surface deformation, a synthesis of the effects of optical pressures produced by a wave train (by penetration or reflection) is undertaken. The hydrodynamic effects are characterized with the aid of a velocity potential. It is seen that Hankel transformations of the deformation and the optical pressures are regulated by a forced harmonic oscillation equation where the limiting frequency is determined by the size of the laser beam, the liquid density, the surface tension coefficient, and the gravity field. For a certain value of the gravity field, the surface tension plays a large role in the deformation. It is calculated that the value of the surface deformation can be several microns. This could significantly influence the morphology and probably certain physical properties of particles laser-treated in microgravity. At a certain intensity of the pulsed laser beam, a large number of other mechanisms can become important; in certain cases, this can favor the utilization of certain technologies for materials processing in microgravity, where weak forces can play an important role. Author (CISTI)

N93-21127# MPB Technologies, Inc., Sainte-Anne-de-Bellevue (Quebec).
PROGRESS IN THE DEVELOPMENT OF THE LASER-BASED R/D TEST-BED SYSTEM Abstract Only **c36**
M. Olivier, S. Simard, A. Laferriere, L. Audet, P. Langlois (National Optics Inst., Ste-Foy, Quebec.), and E. Harvey (National Optics Inst., Ste-Foy, Quebec.) *In* Canadian Space Agency, Spacebound 1991 1991 p 295 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

The LTS is a modular, multi-user facility for variable gravity research that can be flown aboard the NASA KC-135 aircraft. The LTS provides a convenient support for mounting special purpose equipment such as interferometers, charge coupled device cameras, or growth cells, and at the same time is supplemented by generic peripherals such as control and data acquisition electronics, high power lasers, beam delivery and monitoring optics, linear translation stages, and user-friendly experiment control software. This concept was developed for the Canadian Space Agency to fulfill the needs of the scientific community for research in variable gravity environments. The specifications of the system are summarized and the performances of the facility are discussed. The potential for application of the Moire deflectometry and real-time holographic interferometry optical modules of the LTS, for the study of fluid dynamics phenomena, is reviewed, and experimental results obtained using these techniques are presented. Image processing software currently being developed to facilitate the analysis of interference and Moire patterns is also briefly described.
Author (CISTI)

N93-21360# European Space Agency, Paris (France). Space Science Dept.
ESA'S REPORT TO THE 29TH COSPAR MEETING
T. Appourchaux, A. Chicarro, V. Domingo, M. Fridlund, M. Huber, L. Innocenti, P. Jakobsen, M. Kessler, J. P. Lebreton, and A. Parmar et al Aug. 1992 173 p Meeting held in Washington, DC, Sep. 1992 Original contains color illustrations
(ESA-SP-1154; ISBN-92-9092-053-X; ETN-93-93083) Copyright Avail: CASI HC A08/MF A02

All ESA missions in operation, under development, or in planning are described. Missions beyond the operational phase are also presented if considerable effort is still being expended in supporting the data analysis

through an archive. The aging and completed missions are: IUE, Exosat, Hipparcos, Giotto extended mission, Ulysses, and Hubble Space Telescope. The projects under development are: Infrared Space Observatory (ISO), the Solar Terrestrial Science Program (STSP) (which comprises the four Cluster spacecraft and the Solar and Heliospheric Observatory (SOHO)), the X-ray Multimirror Mission (XMM) and the Cassini/Huygens mission. Missions under study are: the Far Infrared Space Telescope (FIRST), the comet nucleus sample return (Rosetta), the International Gamma Ray Laboratory (INTEGRAL), a network of three semi hard landers to be placed on the Martian surface (MARSNET), a mission for probing the interior and rotation of stars (PRISMA), and a Satellite Test of the Equivalence Principle (STEP). Missions beyond Horizon 2000 are: Return to the Moon, interferometry from space, and Vulcan. ESA platforms described are Eureca (the European retrieval carrier) and Simuris (a solar system and stellar interferometric mission for ultrahigh resolution imaging and spectroscopy). ESA

N93-21407*# National Aeronautics and Space Administration, Washington, DC.

NASA AUTOMATED RENDEZVOUS AND CAPTURE REVIEW. EXECUTIVE SUMMARY Abstracts Only

1991 55 p Review held in Williamsburg, VA, 19-21 1991 Prepared in cooperation with Spectra Research Systems, Inc., Arlington, VA

(Contract NASw-4341)

(NASA-TM-108597; NAS 1.15:108597) Avail: CASI HC A04/MF A01

In support of the Cargo Transfer Vehicle (CTV) Definition Studies in FY-92, the Advanced Program Development division of the Office of Space Flight at NASA Headquarters conducted an evaluation and review of the United States capabilities and state-of-the-art in Automated Rendezvous and Capture (AR&C). This review was held in Williamsburg, Virginia on 19-21 Nov. 1991 and included over 120 attendees from U.S. government organizations, industries, and universities. One hundred abstracts were submitted to the organizing committee for consideration. Forty-two were selected for presentation. The review was structured to include five technical sessions. Forty-two papers addressed topics in the five categories below: (1) hardware systems and components; (2) software systems; (3) integrated systems; (4) operations; and (5) supporting infrastructure. For individual titles, see N93-21408 through N93-21449.

N93-21408*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

COHERENT DOPPLER LIDAR FOR AUTOMATED SPACE VEHICLE RENDEZVOUS, STATIONKEEPING AND CAPTURE Abstract Only **c36**

James A. Bilbro *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 6 (For primary document see N93-21407 07-12)

Avail: CASI HC A01/MF A01

The inherent spatial resolution of laser radar makes ladar or lidar an attractive candidate for Automated Rendezvous and Capture application. Previous applications were based on incoherent lidar techniques, requiring retro-reflectors on the target vehicle. Technology improvements (reduced size, no cryogenic cooling requirement) have greatly enhanced the construction of coherent lidar systems. Coherent lidar permits the acquisition of non-cooperative targets at ranges that are limited by the detection capability rather than by the signal-to-noise ratio (SNR) requirements. The sensor can provide translational state information (range, velocity, and angle) by direct measurement and, when used with any array detector, also can provide attitude information by Doppler imaging techniques. Identification of the target is accomplished by scanning with a high pulse repetition frequency (dependent on the SNR). The system performance is independent of range and should not be constrained by sun angle. An initial effort to characterize a multi-element detection system has resulted in a system that is expected to work to a minimum range of 1 meter. The system size, weight and power requirements are dependent on the operating range; 10 km range requires a diameter of 3 centimeters with overall size at 3 x 3 x 15 to 30 cm, while 100 km range requires a 30 cm diameter. Author (revised)

N93-21409*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

VIDEO GUIDANCE SENSOR Abstract Only **c36**

Richard Howard *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 6 (For primary document see N93-21407 07-12)

Avail: CASI HC A01/MF A01

A Martin-Marietta study comparing the application of laser, video, or RF sensors was conducted in 1982. The study concluded that video was the most attractive sensor (the video also could be used for operator monitoring). The Retro-Reflector field Tracker from the Solar Array Flight Experiment was chosen as a 'first generation' sensor and integrated with guidance algorithms for evaluation on the air-bearing vehicle. Results indicated that this sensor was not applicable for the noise environment posed by the multi-layer insulation used on most spacecraft. A 'second generation' sensor was developed to be used with a modified RMS target. This sensor utilized two sets of laser diodes to acquire three optically filtered targets. The targets were illuminated first with a 780 nanometer diode, followed by illumination with a 830 nm diode. The second digitized picture was subtracted from the first to get a low-noise image. The centroids of the retroreflectors were used then to uniquely derive target attitude and range. The sensor presently operates to 80 feet and within +/- 40 degrees in pitch and yaw. Sensor operability is a concern if the sun is within a +/- 40 degree cone angle to the target. The present sensor performance characteristics are less than 1 percent range error and less than 1 degree angle error. Future sensor development is anticipated to extend the operating range to 150 feet and reduce the cone angle of sensor inoperability to within +/- 10 degrees of direct sunlight. Performance improvements also are anticipated. TRW currently is developing a system that utilizes dual cameras with simultaneous diode illumination. Although further development is being pursued, the basic system has proven sound, and the sensor is essentially ready for application. Author (revised)

N93-21410*# Rockwell International Corp., Seal Beach, CA.

APPROACH RANGE AND VELOCITY DETERMINATION USING LASER SENSORS AND RETROREFLECTOR TARGETS Abstract Only **c36**

William J. Donovan *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 6-7 (For primary document see N93-21407 07-12)

Avail: CASI HC A01/MF A01

A laser docking sensor study is currently in the third year of development. The design concept is considered to be validated. The concept is based on using standard radar techniques to provide range, velocity, and bearing information. Multiple targets are utilized to provide relative attitude data. The design requirements were to utilize existing space-qualifiable technology and require low system power, weight, and size yet, operate from 0.3 to 150 meters with a range accuracy greater than 3 millimeters and a range rate accuracy greater than 3 mm per second. The field of regard for the system is +/- 20 deg. The transmitter and receiver design features a diode laser, microlens beam steering, and power control as a function of range. The target design consists of five target sets, each having seven 3-inch retroreflectors, arranged around the docking port. The target map is stored in the sensor memory. Phase detection is used for ranging, with the frequency range-optimized. Coarse bearing measurement is provided by the scanning system (one set of binary optics) angle. Fine bearing measurement is provided by a quad detector. A MIL-STD-1750 A/B computer is used for processing. Initial test results indicate a probability of detection greater than 99 percent and a probability of false alarm less than 0.0001. The functional system is currently at the MIT/Lincoln Lab for demonstration. Author (revised)

N93-21411*# TRW, Inc., Redondo Beach, CA. Federal System Div.

CONTACT DYNAMICS TESTING OF AUTOMATED THREE-POINT DOCKING MECHANISM Abstract Only **c18**

Kenneth H. Rourke *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 7 (For primary document see N93-21407 07-12)

Avail: CASI HC A01/MF A01

An evaluation of an OMV docking mechanism, based on an adaptation of the Shuttle Flight Support System Pallet Berthing Mechanism was completed. The mechanism uses automatically actuated motorized latches to engage towel bars on the target satellite. LED sensors establish the towel bar position within the capture envelope and the latch capture commands are issued. Then, locking pawls engage the bar, locking and pre-loading the mechanism. Two series of tests were conducted to test nominal and failure mode captures and to evaluate design parameters

such as LED sensor locations, automatic closure algorithms, latch closure velocity, position/velocity entry envelopes, and closure method. The first test series involved single latch testing on the Flat Floor Facility, the 6 DOF Facility, and an analytic simulation model. The intent was to compare results in order to validate the various facilities. Reasonably good agreement was achieved. The second test series repeated the single latch testing on the refurbished 6 DOF Facility to validate the facility modifications. The individual latches were tested under free-drift conditions for functionality and performance. Next, the three-latch configuration underwent parametric testing. Test results validated the improved fidelity of the 6 DOF Facility and verified successful docking at the required entry velocity. The tests determined the 'best' design parameter definitions and concluded that the locking pawls should not lock until all three latches completely close.
Author (revised)

N93-21412*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
TRAC BASED SENSING FOR AUTONOMOUS RENDEZVOUS Abstract Only **c18**
Louis J. Everett (Texas A&M Univ., College Station.) and Leo Monford *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 7-8 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

The Targeting Reflective Alignment Concept (TRAC) sensor is to be used in an effort to support an Autonomous Rendezvous and Docking (AR&D) flight experiment. The TRAC sensor uses a fixed-focus, fixed-iris CCD camera and a target that is a combination of active and passive components. The system experiment is anticipated to fly in 1994 using two Commercial Experiment Transporters (COMET's). The requirements for the sensor are: bearing error less than or equal to 0.075 deg; bearing error rate less than 0.3 deg/sec; attitude error less than 0.5 deg.; and attitude rate error less than 2.0 deg/sec. The range requirement depends on the range and the range rate of the vehicle. The active component of the target is several 'kilo-bright' LED's that can emit 2500 millicandela with 40 milliwatts of input power. Flashing the lights in a known pattern eliminates background illumination. The system should be able to rendezvous from 300 meters all the way to capture. A question that arose during the presentation: What is the life time of the LED's and their sensitivity to radiation? The LED's should be manufactured to Military Specifications, coated with silicon dioxide, and all other space qualified precautions should be taken. The LED's will not be on all the time so they should easily last the two-year mission. Author (revised)

N93-21413*# Lockheed Engineering and Sciences Co., Houston, TX.
APPLICABILITY OF RELATIVE GPS TO AUTOMATED RENDEZVOUS BETWEEN THE SPACE SHUTTLE AND SPACE STATION Abstract Only **c04**
Fred D. Clark and Ann Christofferson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 8 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

The purpose of this study is to determine the adequacy of the Global Positioning System (GPS) in providing relative navigation for automated rendezvous and proximity operations. The study was performed using the Proximity Operations Simulator (POS), Lockheed's high-fidelity, six-degree-of-freedom simulation of the Space Shuttle and Space Station. This simulation includes identical models of GPS receivers for each vehicle. The navigation software in each vehicle includes identical Kalman filters. Each vehicle estimates its own state, and the relative state is obtained by simply subtracting absolute states. Author (revised)

N93-21414*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
TRAJECTORY CONTROL SENSOR ENGINEERING MODEL DETAILED TEST OBJECTIVE Abstract Only **c19**
Kent Dekome and Joseph Martin Barr (Lockheed Engineering and Sciences Co., Houston, TX.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 9 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

The concept employed in an existing Trajectory Control Sensor (TCS) breadboard is being developed into an engineering model to be considered for flight on the Shuttle as a Detailed Test Objective (DTO). The sensor design addresses the needs of Shuttle/SSF docking/berthing by providing relative range and range rate to 1500 meters as well as the perceived needs of AR&C by relative attitude measurement over the last 100 meters. Range measurement is determined using a four-tone ranging technique. The Doppler shift on the highest frequency tone will be used to provide direct measurement of range rate. Bearing rate and attitude rates will be determined through back differencing of bearing and attitude, respectively. The target consists of an isosceles triangle configuration of three optical retroreflectors, roughly one meter and one-half meter in size. After target acquisition, the sensor continually updates the positions of the three retros at a rate of about one hertz. The engineering model is expected to weigh about 25 pounds, consume 25-30 watts, and have an envelope of about 1.25 cubic feet. The following concerns were addressed during the presentation: are there any concerns with differentiating attitude and bearing to get attitude and bearing rates? Since the docking scenario has low data bandwidth, back differencing is a sufficient approximation of a perfect differentiator for this application. Could range data be obtained if there were no retroreflectors on the target vehicle? Possibly, but only at close range. It would be dependent on target characteristics. Author (revised)

N93-21415*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
THRUSTER CONFIGURATIONS FOR MANEUVERING HEAVY PAYLOADS Abstract Only **c18**
Roy K. Tsugawa (TRW, Inc., Redondo Beach, CA.), Michael E. Draznin (TRW, Inc., Redondo Beach, CA.), and Richard W. Dabney *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 9-10 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

The Cargo Transfer Vehicle (CTV) will be required to perform six degree of freedom (6 DOF) maneuvers while carrying a wide range of payloads varying from 100,000 lbm to no payload. The current baseline design configuration for the CTV uses a forward propulsion module (FPM) mounted in front of the payload with the CTV behind the payload so that the center of gravity (CG) of the combined stack is centered between the thruster sets. This allows for efficient rotations and translations of heavy payloads in all directions; however, the FPM is a costly item, so it is desirable to find design solutions that do not require the FPM. This presentation provides an overview of the analysis of the FPM requirements for the CTV. In this study, only the reaction control system (RCS) thruster configurations are considered for 6 DOF maneuvers of various CTV cargo configurations. An important output of this study are the viable alternative thruster configurations that eliminate the need for the FPM. Initial results were derived using analytical techniques and simulation analysis tools. Results from the preliminary analysis were validated using our 6 DOF simulation. Author

N93-21416*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
OPTICAL CORRELATORS FOR AUTOMATED RENDEZVOUS AND CAPTURE Abstract Only **c74**
Richard D. Juday *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 10-11 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

The paper begins with a description of optical correlation. In this process, the propagation physics of coherent light is used to process images and extract information. The processed image is operated on as an area, rather than as a collection of points. An essentially instantaneous convolution is performed on that image to provide the sensory data. In this process, an image is sensed and encoded onto a coherent wavefront, and the propagation is arranged to create a bright spot of the image to match a model of the desired object. The brightness of the spot provides an indication of the degree of resemblance of the viewed image to the mode, and the location of the bright spot provides pointing information. The process can be utilized for AR&C to achieve the capability to identify objects among known reference types, estimate the object's location and orientation, and interact with the control system. System characteristics (speed, robustness, accuracy, small form factors) are adequate to meet

most requirements. The correlator exploits the fact that Bosons and Fermions pass through each other. Since the image source is input as an electronic data set, conventional imagers can be used. In systems where the image is input directly, the correlating element must be at the sensing location.
Author (revised)

N93-21417*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
OFFICE OF SPACEFLIGHT STANDARD SPACEBORNE GLOBAL POSITIONING SYSTEM (GPS) USER EQUIPMENT PROJECT Abstract Only **c04**
Penny E. Saunders *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 11-12 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

The Global Positioning System (GPS) provides the following: (1) position and velocity determination to support vehicle GN&C, precise orbit determination, and payload pointing; (2) time reference to support onboard timing systems and data time tagging; (3) relative position and velocity determination to support cooperative vehicle tracking; and (4) attitude determination to support vehicle attitude control and payload pointing.
Author (revised)

N93-21418*# Lockheed Engineering and Sciences Co., Houston, TX.
AUTONOMOUS PRE-ALIGNMENT OF A DOCKING MECHANISM Abstract Only **c18**
Monty B. Carroll and John A. Thompson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 12 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

The subject project can be described as the development and testing of a digitally controlled docking mechanism. The mechanism consists of a 6 DOF parallel manipulator for docking interface pre-alignment, and a machine vision sensor for real-time target tracking. The parallel manipulator also can be used for capture/latching, energy attenuation, and structural rigidization of docking, but the scope of this paper is the proof-of-concept demonstration of autonomous pre-alignment of a docking mechanism using machine vision.
Author (revised)

N93-21419*# Motorola, Inc., Chandler, AZ. Strategic Electronics Div.
RENDEZVOUS RADAR FOR THE ORBITAL MANEUVERING VEHICLE Abstract Only **c32**
John W. Locke, Keith A. Olds, and Thomas Quaid *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 13 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

The Rendezvous Radar Set (RRS) was designed at Motorola's Strategic Electronics Division in Chandler, Arizona, to be a key subsystem aboard NASA's Orbital Maneuvering Vehicle (OMV). The unmanned OMV, which was under development at TRW's Federal Systems Division in Redondo Beach, California, was designed to supplement the Shuttle's satellite delivery, retrieval, and maneuvering activities. The RRS was to be used to locate and then provide the OMV with vectoring information to the target satellite (or Shuttle or Space Station) to aid the OMV in making a minimum fuel consumption approach and rendezvous. The OMV development program was halted by NASA in 1990 just as parts were being ordered for the RRS engineering model. The paper presented describes the RRS design and then discusses new technologies, either under development or planned for development at Motorola, that can be applied to radar or alternative sensor solutions for the Automated Rendezvous and Capture problem.
Author (revised)

N93-21420*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
A BERTHING AND FASTENING STRATEGY FOR ORBITAL REPLACEMENT UNITS Abstract Only **c18**
John Vranish and Edward Cheung *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 13-14 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

A summary of the GSFC applied research effort in robotic berthing is provided. The summary includes several demonstrations and experimental highlights illustrated on video. Two GSFC developments are central to the research, the 'Capaciflector' sensor and the 'Spline-Locking Screw fastener.
Author (revised)

N93-21421*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
A BINOCULAR STEREO APPROACH TO AR/C AT THE JOHNSON SPACE CENTER Abstract Only **c32**
Timothy E. Fisher and Alan T. Smith (Lockheed Engineering and Sciences Co., Houston, TX.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 14-15 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

Automated Rendezvous and Capture requires the determination of the 6 DOF relating two free bodies. Sensor systems that can provide such information have varying sizes, weights, power requirements, complexities, and accuracies. One type of sensor system that can provide several key advantages is a binocular stereo vision system.
Author (revised)

N93-21422*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A COMPARISON OF LASER-BASED RANGING SYSTEMS FOR AR/C Abstract Only **c36**
Stephen J. Katzberg and Pleasant W. Goode, IV *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 15-16 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

The three most common types of laser target ranging (time-of-flight, tone modulated, and FM-CW) are discussed in terms of principle of operation. The first, time-of-flight, is shown to depend more on the ability of support electronics than the fundamentals of the concept. Examples in the literature are cited to show the remarkably good performance of time-of-flight systems. A system developed in Finland was shown to have an incremental ranging capability of a few millimeters. The system is not only robust; it does not include additions such as reference legs and the like, which are expected, for improvement in performance. Though not immediately obvious, the second technique, tone modulated ranging is somewhat of an extension of the time-of-flight technique. Finally, the FM-CW technique is presented. This is completely different from the tone or time-of-flight techniques, but is a direct translation of the same-named technique used in radar ranging systems.
Author (revised)

N93-21423*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
DEMONSTRATION OF AUTOMATED PROXIMITY AND DOCKING TECHNOLOGIES Abstract Only **c18**
Robert L. Anderson (TRW, Inc., Redondo Beach, CA.), Roy K. Tsugawa (TRW, Inc., Redondo Beach, CA.), and Thomas C. Bryan *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 16 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

An autodock was demonstrated using straightforward techniques and real sensor hardware. A simulation testbed was established and validated. The sensor design was refined with improved optical performance and image processing noise mitigation techniques, and the sensor is ready for production from off-the-shelf components. The autonomous spacecraft architecture is defined. The areas of sensors, docking hardware, propulsion, and avionics are included in the design. The Guidance Navigation and Control architecture and requirements are developed. Modular structures suitable for automated control are used. The spacecraft system manager functions including configuration, resource, and redundancy management are defined. The requirements for autonomous spacecraft executive are defined. High level decisionmaking, mission planning, and mission contingency recovery are a part of this. The next step is to do flight demonstrations. After the presentation the following question was asked. How do you define validation? There are two components to validation definition: software simulation with formal and vigorous validation, and hardware and facility performance validated with respect to software already validated against analytical profile.
Author (revised)

N93-21424*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
INTELLIGENT SYSTEMS TECHNOLOGY INFRASTRUCTURE FOR INTEGRATED SYSTEMS Abstract Only **c61**
Henry Lum *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 17 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

A system infrastructure must be properly designed and integrated from the conceptual development phase to accommodate evolutionary intelligent technologies. Several technology development activities were identified that may have application to rendezvous and capture systems. Optical correlators in conjunction with fuzzy logic control might be used for the identification, tracking, and capture of either cooperative or non-cooperative targets without the intensive computational requirements associated with vision processing. A hybrid digital/analog system was developed and tested with a robotic arm. An aircraft refueling application demonstration is planned within two years. Initially this demonstration will be ground based with a follow-on air based demonstration. System dependability measurement and modeling techniques are being developed for fault management applications. This involves usage of incremental solution/evaluation techniques and modularized systems to facilitate reuse and to take advantage of natural partitions in system models. Though not yet commercially available and currently subject to accuracy limitations, technology is being developed to perform optical matrix operations to enhance computational speed. Optical terrain recognition using camera image sequencing processed with optical correlators is being developed to determine position and velocity in support of lander guidance. The system is planned for testing in conjunction with Dryden Flight Research Facility. Advanced architecture technology is defining open architecture design constraints, test bed concepts (processors, multiple hardware/software and multi-dimensional user support, knowledge/tool sharing infrastructure), and software engineering interface issues.
Author (revised)

N93-21425*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
RESULTS OF PROTOTYPE SOFTWARE DEVELOPMENT FOR AUTOMATION OF SHUTTLE PROXIMITY OPERATIONS Abstract Only **c61**
Hal Hiers and Oscar Olszweski (Lockheed Engineering and Sciences Co., Houston, TX.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 17 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

The effort involves demonstration of expert system technology application to Shuttle rendezvous operations in a high-fidelity, real-time simulation environment. The JSC Systems Engineering Simulator (SES) served as the test bed for the demonstration. Rendezvous applications were focused on crew procedures and monitoring of sensor health and trajectory status. Proximity operations applications were focused on monitoring, crew advisory, and control of the approach trajectory. Guidance, Navigation, and Control areas of emphasis included the approach, transition and stationkeeping guidance, and laser docking sensor navigation. Operator interface displays for monitor and control functions were developed. A rule-based expert system was developed to manage the relative navigation system/sensors for nominal operations and simple failure contingencies. Testing resulted in the following findings; (1) the developed guidance is applicable for operations with LVLH stabilized targets; (2) closing rates less than 0.05 feet per second are difficult to maintain due to the Shuttle translational/rotational cross-coupling; (3) automated operations result in reduced propellant consumption and plume impingement effects on the target as compared to manual operations; and (4) braking gates are beneficial for trajectory management. A versatile guidance design was demonstrated. An accurate proximity operations sensor/navigation system to provide relative attitude information within 30 feet is required and redesign of the existing Shuttle digital autopilot should be considered to reduce the cross-coupling effects. This activity has demonstrated the feasibility of automated Shuttle proximity operations with the Space Station Freedom. Indications are that berthing operations as well as docking can be supported. Author (revised)

N93-21426*# Mayflower Communications Co., Inc., Reading, MA.
AUTONOMOUS RECONFIGURABLE GPS/INS NAVIGATION AND POINTING SYSTEM FOR RENDEZVOUS AND DOCKING Abstract Only **c04**
Triveni M. Upadhyay *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 18 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

The briefing describes work using the Global Positioning System to determine position of spacecraft and the development of computer tools to utilize these position determinations to enable autonomous rendezvous. Using GPS data in conjunction with Inertial Navigation Systems (INS) provides the capability for absolute spacecraft navigation, navigation of one spacecraft relative to another, and attitude determination. Some results presented are based on limited observations, though simulation results are documented. A GPS/INS navigation flight experiment could provide a platform for evaluating approaches for autonomous operation and reconfigurability of the navigation and attitude determination subsystem for future space vehicles. Current emphasis is on the development and demonstration of an Onboard Mission Manager (OMM) and a Multi-Mode Navigation Kalman filter. Sensor data will be handed over to the OMM, which will determine the appropriate response and generate commands for the Kalman filter to use to reconfigure itself. Global Positioning System measurements and INS data will be processed in the integrated navigation filter and used to compute errors in position, velocity, and attitude. Inertial Navigation Systems instrument errors (biases, scale factors, etc.) also can be estimated. The OMM then will use a knowledge base to determine appropriate system response. The GPS is good for missions that have attitude pointing accuracy requirements within the 100 to 200 arcsecond range. Author (revised)

N93-21427*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
AUTONOMOUS RENDEZVOUS AND CAPTURE SYSTEM DESIGN Abstract Only **c18**
Richard Dabney *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 19-20 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

The presentation addressed the different tradeoffs necessary to get an automated rendezvous and capture system design that meets the current requirements. The topics covered are piloted versus autonomous capture design considerations, navigation sensor selection tradeoffs, control algorithm design requirements and concepts, performance evaluation through simulation, system mission readiness verification and validation, and advanced AR&C control system technologies. Author (revised)

N93-21428*# McDonnell-Douglas Space Systems Co., Houston, TX.
PROXIMITY OPERATIONS CONSIDERATIONS AFFECTING SPACECRAFT DESIGN Abstract Only **c18**
Steven K. Staas *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 21 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

Proximity operations can be defined as the maneuvering of two or more spacecraft within 1 nautical mile range, with relative velocity less than 10 feet per second. The passive vehicle is nontranslating and should provide for maintenance of the desired approach attitude. It must accommodate the active (translating) vehicle induced structural loads and performance characteristics (mating hardware tolerances), and support sensor compatibility (transponder, visual targets, etc.). The active vehicle must provide adequate sensor systems (relative state information, field-of-view, redundancy), flight control hardware (thruster sizing, minimal cross-coupling, performance margins, redundancy) and software (reconfigurable, attitude/rate modes, translation and rotation fine control authority) characteristic, and adequate non-propulsive consumables such as power. Operational concerns must be considered. These include the following: (1) the desired approach trajectory and relative orientation; (2) the active vehicle thruster plume effects (forces, torques, contamination) on the passive vehicle; and (3) procedures for contingencies such as loss of communications, sensor or propulsion failures, and target vehicle loss of control. Author (revised)

N93-21429*# Martin Marietta Corp., Denver, CO. Civil Space and Communications Div.

GUIDELINE REQUIREMENTS FOR SERVICEABLE SPACECRAFT GRASPING/BERTHING/DOCKING INTERFACES BASED ON SIMULATIONS AND FLIGHT EXPERIENCE Abstract Only **c18**

Allen B. Thompson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 21 (For primary document see N93-21407 07-12)

Avail: CASI HC A01/MF A01

The described efforts support a NASA Space Assembly and Servicing Working Group activity to draft guideline interface standards. The general requirements are to provide a simple, reliable, and durable system. Interface requirements developed include lateral position offset, axial and lateral velocities, and angular misalignment. A survey of concepts and simulation studies of spacecraft docking, existing docking/end effector performance criteria, and space proven, qualified docking data was conducted and evaluated, in order to provide recommended mechanical interface guidelines and interface tolerances for manual and autonomous capture operations. The criterion for the selection of the guidelines was maximum capability to handle malfunctions. Originally the guidelines for a zero velocity docking were considered to be covered within the grasping/berthing definition. It is acknowledged that perhaps a separate category needs to be established for this operation. The draft standard was delivered to the AIAA for review, revision, and issuance as the first U.S. national standard guideline on interfaces. The intent is to develop the guidelines into an International Standards Organization standard. Author (revised)

N93-21430*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

AUTONOMOUS DOCKING GROUND DEMONSTRATION Abstract Only **c18**

Steve L. Lamkin, Thomas Quan Le, L. T. Othon, Joseph L. Prather, Richard E. Eick (TRW, Inc., Houston, TX.), Jim M. Baxter (TRW, Inc., Houston, TX.), M. G. Boyd (Lockheed Engineering and Sciences Co., Houston, TX.), Fred D. Clark (Lockheed Engineering and Sciences Co., Houston, TX.), Peter T. Spehar (Lockheed Engineering and Sciences Co., Houston, TX.), and Rebecca T. Teters (Lockheed Engineering and Sciences Co., Houston, TX.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 21-22 (For primary document see N93-21407 07-12)

Avail: CASI HC A01/MF A01

The Autonomous Docking Ground Demonstration is an evaluation of the laser sensor system to support the docking phase (12 ft to contact) when operated in conjunction with the guidance, navigation, and control (GN&C) software. The docking mechanism being used was developed for the Apollo/Soyuz Test Program. This demonstration will be conducted using the 6-DOF Dynamic Test System (DTS). The DTS simulates the Space Station Freedom as the stationary or target vehicle and the Orbiter as the active or chase vehicle. For this demonstration, the laser sensor will be mounted on the target vehicle and the retroflectors will be on the chase vehicle. This arrangement was chosen to prevent potential damage to the laser. The laser sensor system, GN&C, and 6-DOF DTS will be operated closed-loop. Initial conditions to simulate vehicle misalignments, translational and rotational, will be introduced within the constraints of the systems involved. Author (revised)

N93-21431*# General Dynamics Corp., San Diego, CA. Space Systems Div.

AN OVERVIEW OF AUTONOMOUS RENDEZVOUS AND DOCKING SYSTEM TECHNOLOGY DEVELOPMENT Abstract Only **c18**

Kurt D. Nelson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 22-23 (For primary document see N93-21407 07-12)

Avail: CASI HC A01/MF A01

The Centaur upper stage was selected for an airborne avionics modernization program. The parts used in the existing avionics units were obsolete. Continued use of existing hardware would require substantial redesign, yet would result in the use of outdated hardware. Out of date processes, with very expensive and labor intensive technologies, were being used for manufacturing. The Atlas/Centaur avionics were to be procured at a fairly high rate that demanded the use of modern components. The new avionics also reduce size, weight, power, and parts count with a dramatic improvement in reliability. Finally, the cost leverage derived from upgrading the avionics as opposed to any other subsystem for the existing Atlas/Centaur was a very large consideration in the upgrade decision. The upgrade program is a multiyear effort that began in 1989. It includes telemetry, guidance and navigation, control electronics, thrust vector control, and redundancy levels. Author (revised)

N93-21432*# General Dynamics Corp., San Diego, CA. Space Systems Div.

AN AUTONOMOUS RENDEZVOUS AND DOCKING SYSTEM USING CRUISE MISSILE TECHNOLOGY Abstract Only **c18**

Ed Jones and Bruce Nicholson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 23-24 (For primary document see N93-21407 07-12)

Avail: CASI HC A01/MF A01

In November 1990 General Dynamics demonstrated an AR&D system for members of the Strategic Avionics Technology Working Group. This simulation utilized prototype hardware derived from the Cruise Missile and Centaur avionics systems. The object of this proof of concept demonstration was to show that all the accuracy, reliability, and operational requirements established for a spacecraft to dock with Space Station Freedom could be met by the proposed AR&D system. Author

N93-21433*# Fairchild Space Co., Germantown, MD.

ON-ORBIT DEMONSTRATIONS OF AUTOMATED CLOSURE AND CAPTURE USING ESA-DEVELOPED PROXIMITY OPERATIONS TECHNOLOGIES AND AN EXISTING SERVICEABLE NASA EXPLORER PLATFORM SPACECRAFT Abstract Only **c18**

Bill Hohweisner and Jean-Michael Pairot (MATRA Marconi Space, Toulouse, France.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 24-25 (For primary document see N93-21407 07-12)

Avail: CASI HC A01/MF A01

Since 1984 the European Space Agency (ESA) has been working to develop an autonomous rendezvous and docking capability to enable Hermes to dock automatically with Columbus. As a result, ESA (with Matra, MBB, and other space companies) have developed technologies that are directly supportive of the current NASA initiative for Automated Rendezvous and Capture. Fairchild and Matra would like to discuss the results of the applicable ESA/Matra rendezvous and capture developments and suggest how these capabilities could be used together with an existing NASA Explorer Platform satellite to minimize new development and accomplish a cost-effective automatic closure and capture demonstration program. Author

N93-21434*# Logicon Control Dynamics Co., Huntsville, AL.

A METHOD FOR MODELING CONTACT DYNAMICS FOR AUTOMATED CAPTURE MECHANISMS Abstract Only **c37**

Philip J. Williams *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 25-26 (For primary document see N93-21407 07-12)

Avail: CASI HC A01/MF A01

Logicon Control Dynamics develops contact dynamics models for space-based docking and berthing vehicles. The models compute contact forces for the physical contact between mating capture mechanism surfaces. Realistic simulation requires proportionality constants, for calculating contact forces, to approximate surface stiffness of contacting bodies. Proportionality for rigid metallic bodies becomes quite large. Small penetrations of surface boundaries can produce large contact forces. Author

N93-21435*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

A PHASE ONE AR/C SYSTEM DESIGN Abstract Only **c18**

Peter M. Kachmar (Draper, Charles Stark Lab., Inc., Cambridge, MA.), Robert J. Polutchko (Draper, Charles Stark Lab., Inc., Cambridge, MA.), Martin Matusky (Draper, Charles Stark Lab., Inc., Cambridge, MA.), William Chu (Draper, Charles Stark Lab., Inc., Cambridge, MA.), William Jackson, and Moises Montez *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 26-27 (For primary document see N93-21407 07-12)

Avail: CASI HC A01/MF A01

The Phase One AR&C System Design integrates an evolutionary design

based on the legacy of previous mission successes, flight tested components from manned Rendezvous and Proximity Operations (RPO) space programs, and additional AR&C components validated using proven methods. The Phase One system has a modular, open architecture with the standardized interfaces proposed for Space Station Freedom system architecture.
Author (revised)

N93-21436*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
OPERATOR-ASSISTED PLANNING AND EXECUTION OF PROXIMITY OPERATIONS SUBJECT TO OPERATIONAL CONSTRAINTS Abstract Only **c54**
Arthur J. Grunwald and Stephen R. Ellis *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 28 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

Future multi-vehicle operations will involve multiple scenarios that will require a planning tool for the rapid, interactive creation of fuel-efficient trajectories. The planning process must deal with higher-order, non-linear processes involving dynamics that are often counter-intuitive. The optimization of resulting trajectories can be difficult to envision. An interaction proximity operations planning system is being developed to provide the operator with easily interpreted visual feedback of trajectories and constraints. This system is hosted on an IRIS 4D graphics platform and utilizes the Clohessy-Wiltshire equations. An inverse dynamics algorithm is used to remove non-linearities while the trajectory maneuvers are decoupled and separated in a geometric spreadsheet. The operator has direct control of the position and time of trajectory waypoints to achieve the desired end conditions. Graphics provide the operator with visualization of satisfying operational constraints such as structural clearance, plume impingement, approach velocity limits, and arrival or departure corridors. Primer vector theory is combined with graphical presentation to improve operator understanding of suggested automated system solutions and to allow the operator to review, edit, or provide corrective action to the trajectory plan.
Author

N93-21437*# TRW, Inc., Redondo Beach, CA. Federal Systems Div.
COLLISION AVOIDANCE FOR CTV: REQUIREMENTS AND CAPABILITIES Abstract Only **c18**
Thomas Nosek and Kenneth Rourke *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 28 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

Collision avoidance must be ensured during Cargo Transfer Vehicle (CTV) operations near the space station. The design of the Collision Avoidance Maneuver (CAM) will involve analysis of CTV failure modes during rendezvous and proximity operations as well as analysis of possible problems external to the CTV, but that would require CTV to execute a CAM. In considering the requirements and design of the CAM for the CTV, the CAM design for the Orbital Maneuvering Vehicle (OMV) is a useful reference point from which some lessons can be learned and many CTV design options can be set forth.
Author (revised)

N93-21438*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
MMU APPLICATIONS FOR AUTOMATED RENDEZVOUS AND CAPTURE Abstract Only **c18**
Edward Whitsett *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 28-30 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

The Manned Maneuvering Unit (MMU) is a proven free flying platform that can operate in a piloted or unpiloted mode. The MMU is a possible candidate for an on orbit AR&C demonstration. A pilot can transition the system between manual and automated modes, then monitor the automated system for safety.
Author

N93-21439*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE REALTIME OPERATIONS OF THE SPACE SHUTTLE ORBITER DURING RENDEZVOUS AND PROXIMITY OPERATIONS Abstract Only **c16**
Andrew Dougherty *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 30-31 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

The Shuttle first demonstrated the capability to perform precision proximity flying in 1983 when the SPAS-01 satellite was deployed and subsequently retrieved. This flight was intended to validate the capability of the Shuttle to perform proximity operations with a co-orbiting vehicle in preparation for the Solar Maximum Repair mission of the next year.
Author

N93-21440*# National Aeronautics and Space Administration, Washington, DC.
AUTONOMOUS RENDEZVOUS AND DOCKING: A COMMERCIAL APPROACH TO ON-ORBIT TECHNOLOGY VALIDATION Abstract Only **c18**
Peter Tchoryk, Jr. (Environmental Research Inst. of Michigan, Ann Arbor.) and Raymond P. Whitten et al *In its* NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 31-32 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

SpARC, in conjunction with its corporate affiliates, is planning an on-orbit validation of autonomous rendezvous and docking (ARD) technology. The emphasis in this program is to utilize existing technology and commercially available components wherever possible. The primary subsystems to be validated by this demonstration include GPS receivers for navigation, a video-based sensor for proximity operations, a fluid connector mechanism to demonstrate fluid resupply capability, and a compliant, single-point docking mechanism. The focus for this initial experiment will be ELV based and will make use of two residual Commercial Experiment Transporter (COMET) service modules. The first COMET spacecraft will be launched in late 1992 and will serve as the target vehicle. After the second COMET spacecraft has been launched in late 1994, the ARD demonstration will take place. The service module from the second COMET will serve as the chase vehicle.
Author

N93-21441*# Martin Marietta Corp., Denver, CO. Civil Space and Communications Div.
EXPERIMENTAL VALIDATION OF DOCKING AND CAPTURE USING SPACE ROBOTICS TESTBEDS Abstract Only **c37**
John Spofford *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 32 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

Docking concepts include capture, berthing, and docking. The definitions of these terms, consistent with AIAA, are as follows: (1) capture (grasping)--the use of a manipulator to make initial contact and attachment between transfer vehicle and a platform; (2) berthing--positioning of a transfer vehicle or payload into platform restraints using a manipulator; and (3) docking--propulsive mechanical connection between vehicle and platform. The combination of the capture and berthing operations is effectively the same as docking; i.e., capture (grasping) + berthing = docking. These concepts are discussed in terms of Martin Marietta's ability to develop validation methods using robotics testbeds.
Author (revised)

N93-21442*# TRW, Inc., Redondo Beach, CA. Federal Systems Div.
ON-ORBIT OPERATIONAL SCENARIOS, TOOLS, AND TECHNIQUES Abstract Only
Jerry Jennings and James Walker *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 33 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

A derivation of OMV developed PC-based mission planning tools is described. Preliminary application of these tools was used to show that detailed description of events and mission modeling complexity can be accommodated easily. Also, spreadsheet models can be expanded to increase detail.
Author (revised)

N93-21443*# Lockheed Engineering and Sciences Co., Houston, TX.
SIX-DEGREE-OF-FREEDOM TEST FACILITY Abstract Only **c18**
Michelle A. Bittel *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 34 (For primary

document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

Shuttle to Space Station docking has become an important issue in the last few years. Docking sensors have been proposed that will provide the high precision measurements required for the fuel efficient rendezvous and docking of space vehicles. These sensors also will be used for satellite servicing and orbital assembly. The performance of the docking sensors must be tested before they are implemented in a space environment. A 6-DOF test facility was developed at the Tracking and Communications Section, JSC, to test the static and dynamic accuracies of docking sensors. A candidate sensor is evaluated by comparing the sensor's static position and velocity measurements to the more accurate 6-DOF system.

Author (revised)

N93-21444*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

SOVIET AUTOMATED RENDEZVOUS AND DOCKING SYSTEM OVERVIEW Abstract Only **c18**

Elaine M. Hinman and David M. Bushman *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 34-35 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

The Soviets have been performing automated rendezvous and docking for many years. It has been a reliable mode of resupply and reboost. During the course of the Soviet space program, the autodocking system has evolved. The earlier IGLA system was replaced with the current KURS system. Both systems are radar-based. The variation in strength between antennas is used for computing relative positions and attitudes. The active spacecraft has a transponder. From discussions with Soviet engineers, it seems the docking process can be controlled either from the ground or from the active (docking) spacecraft's onboard computer. The unmanned Progress resupply ships regularly dock with the current MIR Space Station. The Soyuz T spacecraft incorporated the IGLA system, and the later Soyuz TM and Progress M Series spacecraft incorporated the KURS. The MIR Complex has both systems installed. The rear port and the KVANT docking port have the IGLA system installed to support earlier Progress ships that use the IGLA. The first Soyuz TM docking occurred in May of 1986, while the first Progress M docked in September of 1989. Author (revised)

N93-21445*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

SUPERVISED AUTONOMOUS RENDEZVOUS AND DOCKING SYSTEM TECHNOLOGY EVALUATION Abstract Only **c18**

Neville I. Marzwell *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 35-36 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

Technology for manned space flight is mature and has an extensive history of the use of man-in-the-loop rendezvous and docking, but there is no history of automated rendezvous and docking. Sensors exist that can operate in the space environment. The Shuttle radar can be used for ranges down to 30 meters, Japan and France are developing laser rangers, and considerable work is going on in the U.S. However, there is a need to validate a flight qualified sensor for the range of 30 meters to contact. The number of targets and illumination patterns should be minimized to reduce operation constraints with one or more sensors integrated into a robust system for autonomous operation. To achieve system redundancy, it is worthwhile to follow a parallel development of qualifying and extending the range of the 0-12 meter MSFC sensor and to simultaneously qualify the 0-30(+) meter JPL laser ranging system as an additional sensor with overlapping capabilities. Such an approach offers a redundant sensor suite for autonomous rendezvous and docking. The development should include the optimization of integrated sensory systems, packaging, mission envelopes, and computer image processing to mimic brain perception and real-time response. The benefits of the Global Positioning System in providing real-time positioning data of high accuracy must be incorporated into the design. The use of GPS-derived attitude data should be investigated further and validated. Author

N93-21446*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

AUTONOMOUS RENDEZVOUS AND CAPTURE DEVELOPMENT INFRASTRUCTURE Abstract Only **c18**

Thomas C. Bryan et al *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 36-37 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

In the development of the technology for autonomous rendezvous and docking, key infrastructure capabilities must be used for effective and economical development. This need involves facility capabilities, both equipment and personnel, to devise, develop, qualify, and integrate ARD elements and subsystems into flight programs. One effective way of reducing technical risks in developing ARD technology is the use of the Low Earth Orbit test facility. Using a reusable free-flying testbed carried in the Shuttle, as a technology demonstration test flight, can be structured to include a variety of sensors, control schemes, and operational approaches. This testbed and flight demonstration concept will be used to illustrate how technologies and facilities at MSFC can be used to develop and prove an ARD system. Author (revised)

N93-21447*# Idaho National Engineering Lab., Idaho Falls.

AUTOMATED TECHNOLOGIES NEEDED TO PREVENT RADIOACTIVE MATERIALS FROM REENTERING THE ATMOSPHERE Abstract Only

David Buden and Joseph A. Angelo, Jr. (Science Applications International Corp., Melbourne, FL.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 37 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

Project SIREN (Search, Intercept, Retrieve, Expulsion Nuclear) was created to identify and evaluate the technologies and operational strategies needed to rendezvous with and capture aerospace radioactive materials (e.g., a distressed or spent space reactor core) before such materials can reenter the terrestrial atmosphere and then to safely move these captured materials to an acceptable space destination for proper disposal. A major component of the current project SIREN effort is the development of an interactive technology model (including a computerized data base) that explores, in building-block fashion, the interaction of the technologies and procedures needed to successfully accomplish a SIREN mission. The SIREN model will include appropriate national and international technology elements--both contemporary and projected into the next century. To obtain maximum flexibility and use, the SIREN technology data base is being programmed for use on 286-class PC's. The major technical elements for a successful SIREN mission include: ground and space-based tracking, launch vehicles of needed payload capacity, telerobotic systems, sensors, capture technologies, and space transport and disposal. However, Project SIREN also will impose specialized requirements including the use of dextrous aerospace systems capable of properly functioning in intense radiation and thermal environments. Author (revised)

N93-21448*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

NASA MSFC HARDWARE IN THE LOOP SIMULATIONS OF AUTOMATIC RENDEZVOUS AND CAPTURE SYSTEMS Abstract Only **c18**

Patrick A. Tobbe (Logicon Control Dynamics Co., Huntsville, AL.), Charles B. Naumann (Logicon Control Dynamics Co., Huntsville, AL.), William Sutton, and Thomas C. Bryan *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 38-39 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

Two complementary hardware-in-the-loop simulation facilities for automatic rendezvous and capture systems at MSFC are described. One, the Flight Robotics Laboratory, uses an 8 DOF overhead manipulator with a work volume of 160 by 40 by 23 feet to evaluate automatic rendezvous algorithms and range/rate sensing systems. The other, the Space Station/Station Operations Mechanism Test Bed, uses a 6 DOF hydraulic table to perform docking and berthing dynamics simulations.

Author (revised)

N93-21449*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

SPACE SHUTTLE PROGRAM: AUTOMATIC RENDEZVOUS, PROXIMITY OPERATIONS, AND CAPTURE Abstract Only **c16**

William Jackson et al *In* NASA, Washington, NASA Automated Rendezvous

and Capture Review. Executive Summary 1991 p 39-40 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

An overview of the current NASA JSC capabilities and ongoing activities for the design, development, and demonstration of AR&C capabilities was provided. The JSC plans for ground and flight tests/demonstrations of progressive AR&C capabilities, using the Space Shuttle are described. The Space Shuttle could provide an effective 'flying test bed' for these demonstrations. Author (revised)

N93-21538*# National Aeronautics and Space Administration, Washington, DC.
PATHWAYS TO EXCELLENCE: A FEDERAL STRATEGY FOR SCIENCE, MATHEMATICS, ENGINEERING, AND TECHNOLOGY EDUCATION
Federal Coordinating Council for Science, Engineering, and Technology
US Science, Mathematics, Engineering, and Technology Education Strategic Plan, FY 1994-FY 1998 1993 50 p Original contains color illustrations
(NASA-EP-288; NAS 1.19:288) Avail: CASI HC A03/MF A01; 24 functional color pages

This Strategic Plan was developed by the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET) through its Committee on Education and Human Resources (CEHR), with representatives from 16 Federal agencies. Based on two years of coordinated interagency effort, the Plan confirms the Federal Government's commitment to ensuring the health and well-being of science, mathematics, engineering, and technology education at all levels and in all sectors (i.e., elementary and secondary, undergraduate, graduate, public understanding of science, and technology education). The Plan represents the Federal Government's efforts to develop a five-year planning framework and associated milestones that focus Federal planning and the resources of the participating agencies toward achieving the requisite or expected level of mathematics and science competence by all students. The priority framework outlines the strategic objectives, implementation priorities, and components for the Strategic Plan and serves as a road map for the Plan. The Plan endorses a broad range of ongoing activities, including continued Federal support for graduate education as the backbone of our country's research and development enterprise. The Plan also identifies three tiers of program activities with goals that address issues in science, mathematics, engineering, and technology education meriting special attention. Within each tier, individual agency programs play important and often unique roles that strengthen the aggregate portfolio. The three tiers are presented in descending order of priority: (1) reforming the formal education system; (2) expanding participation and access; and (3) enabling activities. Derived from text

N93-21284# Embassy of Canada, Tokyo (Japan).
CANADA'S LONGTERM SPACE PLAN AND ISY ACTIVITIES [KANADA NO CHOUKI UCHUU KEIKAKU TO ISY KATSUDOU]
B. Carl Kuhnke *In* Science and Technology Agency, Pre Asia Pacific ISY Conference 23 Mar. 1992 p 49-52 In JAPANESE (For primary document see N93-21270 07-43)
Avail: CASI HC A01/MF A01

N93-21285# Embassy of Pakistan, Tokyo (Japan).
PAKISTAN SPACE AND UPPER ATMOSPHERE RESEARCH COMMISSION [PAKISUTAN UCHUU KUUKAN KENKYUU IINKAI (SUPARCO)]
Mian Suhail Aslam *In* Science and Technology Agency, Pre Asia Pacific ISY Conference 23 Mar. 1992 p 53-55 In JAPANESE (For primary document see N93-21270 07-43)
Avail: CASI HC A01/MF A01

N93-21286# National Space Activities Council, Tokyo (Japan).
PANEL DISCUSSION: ROLES OF SPACE PROGRAM IN THE ASIA PACIFIC REGION [PANERU DISUKASSHON: AJIA TAIHEIYOU CHIIKI NI OKERU UCHUU KAIHATSU NO YAKUWARI]
Tamiya Nomura *In* Science and Technology Agency, Pre Asia Pacific ISY Conference 23 Mar. 1992 p 59-75 In JAPANESE (For primary document see N93-21270 07-43)
Avail: CASI HC A03/MF A01

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

No abstracts in this category.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N93-21002# European Space Agency, Paris (France). ESA Committee for Operations and EGSE Standards.
GROUND SEGMENT INFRASTRUCTURE STANDARDS
Mar. 1992 12 p
(ESA-PSS-07-0-Issue-1; ETN-93-93513) Copyright Avail: CASI HC A03/MF A01; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The top level document of the branch of ESA Procedures, Specifications, and Standards PSS-07 series, which address the ground segment infrastructure operations before launch assembly, integration, and test and after launch (mission control), is presented. The PSS-07 series aims to accomplish the following: achieve commonality and standardization in the ESA Ground Segment Infrastructure (GSI) to be used for the ground electrical testing and in flight operations of spacecraft; define the capabilities of the GSI; and set guidelines for the design of the necessity facilities. The PSS-07 series will also include guidelines concerning the detailed implementation of 'packet telemetry and telecommand' by ESA projects. The PSS-07 series will constitute 'recommended practices', unless the contrary is explicitly stated. The objectives and purpose of the PSS-07 documents are stated, a documentation tree is provided, and management procedures for these documents are specified. ESA

N93-20184*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CAPABILITIES AND CONSTRAINTS OF NASA'S GROUND-BASED REDUCED GRAVITY FACILITIES
Jack Lekan, Eric S. Neumann, and Raymond G. Sotos *In its* The Second International Microgravity Combustion Workshop Feb. 1993 p 45-60 (For primary document see N93-20178 07-29)
Avail: CASI HC A03/MF A03; 11 functional color pages

N93-20487# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.
SAFETY VALIDATION TEST EQUIPMENT OPERATION [ANZENSEI JISSHOU SHIKEN SETSUBI NO UNYOU]
Tadaaki Kurosaki and Takashi Watanabe *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 327-330 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-21100# MPB Technologies, Inc., Sainte-Anne-de-Bellevue (Quebec).
DEVELOPMENT OF THE AQUATIC RESEARCH FACILITY
M. Olivier, S. Simard, A. Laferriere, B. P. Tailor, J. Blezius, and N. Paquin *In* Canadian Space Agency, Spacebound 1991 1991 p 151-157 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21105# Space Industries, Inc., Webster, TX.
THE WAKESHIELD FACILITY: FREE FLYER AND COMMERCIAL EXPERIMENT TRANSPORTER PROGRAMS
Olav Smistad *In* Canadian Space Agency, Spacebound 1991 1991

p 182-188 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N93-20251*# Akron Univ., OH. Dept. of Electrical Engineering.
ANALYSIS OF THE SPACE SHUTTLE MAIN ENGINE SIMULATION
J. Alex DeAbreu-Garcia and John T. Welch Cleveland, OH Jan. 1993 263 p
(Grant NAG3-1031; RTOP 590-21-11)
(NASA-CR-191063; E-7567; NAS 1.26:191063) Avail: CASI HC A12/MF A03

This is a final report on an analysis of the Space Shuttle Main Engine Program, a digital simulator code written in Fortran. The research was undertaken in ultimate support of future design studies of a shuttle life-extending Intelligent Control System (ICS). These studies are to be conducted by NASA Lewis Space Research Center. The primary purpose of the analysis was to define the means to achieve a faster running simulation, and to determine if additional hardware would be necessary for speeding up simulations for the ICS project. In particular, the analysis was to consider the use of custom integrators based on the Matrix Stability Region Placement (MSRP) method. In addition to speed of execution, other qualities of the software were to be examined. Among these are the accuracy of computations, the useability of the simulation system, and the maintainability of the program and data files. Accuracy involves control of truncation error of the methods, and roundoff error induced by floating point operations. It also involves the requirement that the user be fully aware of the model that the simulator is implementing. Author

N93-20313*# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
OPTIMAL GUIDANCE LAW DEVELOPMENT FOR AN ADVANCED LAUNCH SYSTEM Interim Progress Report, 1 Dec. 1990 - 15 Jun. 1991
Anthony J. Calise, Dewey H. Hodges, Martin S. Leung, and Robert R. Bless Jun. 1991 23 p
(Grant NAG1-939)
(NASA-CR-192189; NAS 1.26:192189) Avail: CASI HC A03/MF A01

The proposed investigation on a Matched Asymptotic Expansion (MAE) method was carried out. It was concluded that the method of MAE is not applicable to launch vehicle ascent trajectory optimization due to a lack of a suitable stretched variable. More work was done on the earlier regular perturbation approach using a piecewise analytic zeroth order solution to generate a more accurate approximation. In the meantime, a singular perturbation approach using manifold theory is also under current investigation. Work on a general computational environment based on the use of MACSYMA and the weak Hamiltonian finite element method continued during this period. This methodology is capable of the solution of a large class of optimal control problems. Author

N93-21485# Sandia National Labs., Albuquerque, NM.
AN IMPACT TECHNIQUE TO ACCELERATE FLIER PLATES TO VELOCITIES OVER 12 km/s
L. C. Chhabildas 1991 12 p Presented at the Hypervelocity Impact Symposium, Austin, TX, 17-20 Nov. 1992
(Contract DE-AC04-76DP-00789)
(DE93-002467; SAND-91-2816C; CONF-921162-11) Avail: CASI HC A03/MF A01

Very high pressure and acceleration is necessary to launch flier plates to hypervelocities. In addition, the high pressure loading must be uniform, structured, and shockless, i.e., time-dependent to prevent the flier plate from either fracturing or melting. A technique is described which allows the use of 100 GPa megabar loading pressures and 10(exp 9)-g acceleration to launch intact flier plates to velocities of 12.2 km/s. The technique was used to launch nominally 1-mm thick aluminum, magnesium, and titanium alloy plates to velocities over 10 km/s, and 0.5-mm thick aluminum and titanium alloy plates to velocities of 12.2 km/s. DOE

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

N93-19982# Phillips Lab., Hanscom AFB, MA.
CONTAMINATION SIGNATURES OBSERVED DURING THE CIRRIS-1A MISSION
Byron D. Green, W. T. Rawlins, O. M. Uy, Richard M. Nadile, and Ned Wheeler 29 Oct. 1992 11 p
(AD-A258596; AD-E201281; PL-TR-92-2259) Avail: CASI HC A03/MF A01

The sensitive, high resolution CIRRIS-1A radiometer/interferometer provided a unique capability to probe the optical environment surrounding the shuttle on the STS 39 mission. Ground processing was carefully controlled to minimize the contamination levels. Early in the mission all surfaces were subjected to extended solar exposure. These efforts were successful in that most of the data showed no evidence of contamination effects. However, particulate contamination effects were occasionally observed. The range and size of discrete particles are extracted from the particle radiances, spectral distributions, and blur circles. GRA

N93-19990*# National Aeronautics and Space Administration, Washington, DC.
IMPLEMENTATION OF THE RECOMMENDATIONS OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT Final Status Report
Jun. 1987 182 p Original contains color illustrations
(NASA-TM-108646; NAS 1.15:108646) Avail: CASI HC A09/MF A02; 12 functional color pages

This final status report describes the actions taken by NASA in response to the recommendations of the Presidential Commission on the Space Shuttle Challenger Accident (Mission 51-L). The Commission recommendations and NASA's responses to them are summarized in the Executive Summary, which is accompanied by a schedule showing significant program milestones. A detailed discussion of the activities undertaken by NASA to implement each of the nine Commission recommendations is included and other related NASA actions required for safe return to flight are discussed. A copy of the interim plan submitted to the President one year ago and other significant reference documents are included as appendixes. Author

N93-20036# Presidential Commission on the Space Shuttle Challenger Accident, Washington, DC.
REPORT AT A GLANCE: REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT
William P. Rogers, Neil A. Armstrong, David C. Acheson, Eugene E. Covert, Richard P. Feynman, Robert B. Hotz, Donald J. Kutyna, Sally K. Ride, Robert W. Rummel, and Joseph F. Sutter et al 9 Jun. 1986 31 p
Avail: CASI HC A03/MF A01

The accident of Space Shuttle Challenger, mission 51-L, interrupting for a time one of the most productive engineering, scientific and exploratory programs in history, evoked a wide range of deeply felt public responses. There was grief and sadness for the loss of seven brave members of the crew; firm national resolve that those men and women be forever enshrined in the annals of American heroes, and a determination, based on that resolve and in their memory, to strengthen the Space Shuttle program so that this tragic event will become a milestone on the way to achieving the full potential that space offers to mankind. The President, who was moved and troubled by this accident in a very personal way, appointed an independent Commission made up of persons not connected with the mission to investigate it. The mandate of the Commission was to: (1) Review the circumstances surrounding the accident to establish the probable

cause or causes of the accident; and (2) Develop recommendations for corrective or other action based upon the Commission's finding and determinations. Author

N93-20115* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

SHUTTLE ORBITER WITH TELESCOPING MAIN PROPULSION UNIT AND PAYLOAD Patent

Ian O. MacConochie, inventor (to NASA) 2 Mar. 1993 6 p Filed 7 Aug. 1991 Supersedes N92-10035 (30 - 1, p 8)

(NASA-Case-LAR-13586-1; US-Patent-5,190,246; US-Patent-Appl-SN-743469; US-Patent-Class-244-54; US-Patent-Class-244-118.1; US-Patent-Class-244-118.2; US-Patent-Class-244-172; Int-Patent-Class-B64D-27/02) Avail: US Patent and Trademark Office

An improved Space Shuttle with variable internal volume is provided. The Space Shuttle Orbiter includes a telescoping main propulsion unit. This main propulsion unit contains the main rocket engines and fuel tanks and telescopes into the Space Shuttle. A variable cavity is located between this unit and the crew compartment. Accordingly, the positioning of the telescoping main propulsion unit determines the volume of the variable cavity. Thus, the volume of the variable length of the entire Space Shuttle may be increased or decreased to achieve desired configurations for optimal storage. In one embodiment of the invention, the payload also telescopes within the variable cavity.

Official Gazette of the U.S. Patent and Trademark Office

N93-20121*# Martin Marietta Corp., Denver, CO. Space Launch Systems Co.

INTERPLANETARY PROGRAM TO OPTIMIZE SIMULATED TRAJECTORIES (IPOST). VOLUME 2: ANALYTIC MANUAL Final Report

P. E. Hong, P. D. Kent, D. W. Olson, and C. A. Vallado Oct. 1992 73 p Revised

(Contract NAS1-18230; RTOP 506-49-11-02)

(NASA-CR-189653-Vol-2-Rev; NAS 1.26:189653-Vol-2-Rev) Avail: CASI HC A04/MF A01

The Interplanetary Program to Optimize Space Trajectories (IPOST) is intended to support many analysis phases, from early interplanetary feasibility studies through spacecraft development and operations. The IPOST output provides information for sizing and understanding mission impacts related to propulsion, guidance, communications, sensor/actuators, payload, and other dynamic and geometric environments. IPOST models three degree of freedom trajectory events, such as launch/ascent, orbital coast, propulsive maneuvering (impulsive and finite burn), gravity assist, and atmospheric entry. Trajectory propagation is performed using a choice of Cowell, Encke, Multiconic, Onestep, or Conic methods. The user identifies a desired sequence of trajectory events, and selects which parameters are independent (controls) and dependent (targets), as well as other constraints and the cost function. Targeting and optimization is performed using the Stanford NPSOL algorithm. IPOST structure allows subproblems within a master optimization problem to aid in the general constrained parameter optimization solution. An alternate optimization method uses implicit simulation and collocation techniques. Author

N93-20234*# MCAT Inst., San Jose, CA.

MULTIPLE-BODY SIMULATION WITH EMPHASIS ON INTEGRATED SPACE SHUTTLE VEHICLE Final Report

Ing-Tsau Chiu Feb. 1993 15 p Original contains color illustrations

(Contract NCC2-692)

(NASA-CR-192289; NAS 1.26:192289; MCAT-93-004) Avail: CASI HC A03/MF A01; 6 functional color pages

The program to obtain intergrid communications - Pegasus - was enhanced to make better use of computing resources. Periodic block tridiagonal and penta-diagonal diagonal routines in OVERFLOW were modified to use a better algorithm to speed up the calculation for grids with periodic boundary conditions. Several programs were added to collar grid tools and a user friendly shell script was developed to help users generate collar grids. User interface for HYPGEN was modified to cope with the changes in HYPGEN. ET/SRB attach hardware grids were added to the computational model for the space shuttle and is currently incorporated into the refined shuttle model jointly developed at Johnson Space Center and Ames Research Center. Flow simulation for the integrated space shuttle vehicle at flight Reynolds number was carried out and compared with flight data as well as the earlier simulation for wind tunnel Reynolds number. Author

N93-20744# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.

ANALYSIS OF SPACE SHUTTLE ACCELEROMETER DATA

A. A. tenHave 4 May 1990 12 p Presented at 45th Canadian Symposium on Aerospace Structures and Materials, Toronto, Ontario, 14-15 May 1990

(Contract ESA-5826/84/NL/PB(SC))

(NLR-TP-90141-U; ETN-92-92860) Avail: CASI HC A03/MF A01

Within an ESA program to optimize the damage tolerance approach to design of Space Shuttle payloads, actual flight data from four Space Shuttle missions was analyzed. The task was to derive typical mission event load spectra from load time accelerometer measurements. The quality of the analog input data, available to NASA for preprocessing, was such that derivation of valid load spectra could not be done directly. Prior to actual load spectra assessment, relatively complex procedures were necessary to clear the data, that is to positively identify valid load extremes and to eliminate erroneous data. Using results of the mission event load spectra assessment, synthesis procedures were developed later on to establish a representative test load sequence for use in a fatigue testing program. Characteristics of input data and signal quality aspects are described together with tools to clear the data and the various data handling steps taken to arrive at the final load spectra. ESA

N93-20847# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).

FUTURE SPACE TRANSPORTATION SYSTEMS. PART 1: SAFETY ASPECTS. PART 2: TECHNICAL ASPECTS [ZUKUENFTIGE RAUMTRANSPORTSYSTEME. TEIL 1: VERSICHERUNGSASPEKTE. TEIL 2: TECHNISCHE ASPEKTE]

Ludwig Ploechinger (Allianz Versicherungs A.G., Munich, Germany.) and Heribert Kuczera 1992 10 p Repr. from Der Maschinenschaden, v. 65, no. 2, 1992 p 41-49 In GERMAN Presented at 13th Allianz-Forum Technik und Versicherung, Berlin, Germany, 19 Jun. 1990

(MBB-UK-0180-90-PUB-Pt-1-2; ETN-93-92742) Avail: CASI HC A02/MF A01

Damage statistics on Ariane, Atlas Centaur and Delta flights are examined. The modifications demanded by insurance companies for the Ariane 1, 2 and 3 boosters, equipment bay and first stage reinforcement are reviewed and the new concept of Ariane 5 is described. The progress in horizontal takeoff and landing aircraft with airbreathing propulsion are examined and the German Saenger and its hypersonic technology program are described. ESA

N93-20906# Technische Univ., Berlin (Germany). Fachgebeit Raumfahrzeugtechnik.

PROBLEM SOLVING FOR LONG TERM, GLOBAL SCENARIOS OF SPACE TRAFFIC [ZUR PROBLEMATIK LANGFRISTIGER, GLOBALER SZENARIEN DES WELTRAUMVERKEHRS]

R. E. Lo 30 Nov. 1991 86 p In GERMAN

(ILR-Mitt-265(1991); ETN-93-92593) Avail: CASI HC A05/MF A01

Methods of world space flight planning are examined with a view to forecasting long term development. Problems arising are reported. The cost differences of the various hypotheses are given. Two points are of importance: the transportation infrastructure allowed by the space flight, and the environment which the space flight development occurs. Global master scene analyses are distinguished from specific space master scene analyses. Specific master scene analyses are concrete assumptions on space flight relevant development projects and missions. The influencing parameters of master analyses are identified. ESA

N93-21477*# National Academy of Sciences - National Research Council, Washington, DC. Aeronautics and Space Engineering Board.

FROM EARTH TO ORBIT: AN ASSESSMENT OF TRANSPORTATION OPTIONS

Joseph G. Gavin, Jr., Edmund Blond, Yvonne C. Brill, Bernard Budiansky (Harvard Univ., Cambridge, MA.), Robert S. Cooper (Atlantic Aerospace Electronics Corp., Greenbelt, MD.), Wolfgang H. Demisch (UBS Securities, New York, NY.), Clark W. Hawk (Alabama Univ., Huntsville.), Jack L. Kerrebrock (Massachusetts Inst. of Tech., Cambridge.), Byron K. Lichtenberg

(Omega Aerospace, Inc., Virginia Beach, VA.), and Artur Mager (Mager, Artur, Los Angeles, CA.) 1992 103 p
(Contract NASw-4003)
(NASA-CR-192729; NAS 1.26:192729; PB93-114684; ISBN-0-309-04726-9; LC-92-60204) Avail: CASI HC A06/MF A02

The report assesses the requirements, benefits, technological feasibility, and roles of Earth-to-Orbit transportation systems and options that could be developed in support of future national space programs. Transportation requirements, including those for Mission-to-Planet Earth, Space Station Freedom assembly and operation, human exploration of space, space science missions, and other major civil space missions are examined. These requirements are compared with existing, planned, and potential launch capabilities, including expendable launch vehicles (ELV's), the Space Shuttle, the National Launch System (NLS), and new launch options. In addition, the report examines propulsion systems in the context of various launch vehicles. These include the Advanced Solid Rocket Motor (ASRM), the Redesigned Solid Rocket Motor (RSRM), the Solid Rocket Motor Upgrade (SRMU), the Space Shuttle Main Engine (SSME), the Space Transportation Main Engine (STME), existing expendable launch vehicle engines, and liquid-oxygen/hydrocarbon engines. Consideration is given to systems that have been proposed to accomplish the national interests in relatively cost effective ways, with the recognition that safety and reliability contribute to cost-effectiveness. Related resources, including technology, propulsion test facilities, and manufacturing capabilities are also discussed. GRA

N93-20414# National Space Development Agency, Miyagi (Japan).
RESEARCH ON ADVANCED TRANSPORTATION SYSTEMS [SHOURAIGATA YUSOUKEI NO KENKYUU]
Hirokazu Nagai, Ryouhei Hashimoto, Masataka Nosaka, Yukio Koyari, Yoshio Yamada (National Space Development Agency, Tokyo, Japan.), Keiichirou Noda (National Space Development Agency, Tokyo, Japan.), Suetsugu Shinohara (National Space Development Agency, Tokyo, Japan.), Tetsuichi Itou (National Space Development Agency, Ibaraki, Japan.), Takao Etou (National Space Development Agency, Ibaraki, Japan.), and Yutaka Kaneko (National Space Development Agency, Ibaraki, Japan.) *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 13-18 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A02/MF A03

N93-20423# National Space Development Agency, Ibaraki (Japan). Launch Vehicle and Satellite System Lab.
RESEARCH ON HOPE [HOPE NO KENKYUU]
Tetsuichi Itou, Jirou Kouchiyama, Yoshisada Takizawa, Hiroshi Aoki, Akihiro Eguchi, Yasuomi Kanou, Atsushi Murakami, Yasuji Hara, Hideo Bitou, and Yutaka Kaneko et al *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 61-64 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20424# National Space Development Agency, Ibaraki (Japan). Total System Analysis Lab.
CONCEPT OF OVERALL OPERATION OF H-2 ORBITING PLANE (HOPE) [HOPE ZENTAI UNYOU KOUSOU]
Yoshiaki Suzuki, Kenji Nishiyama, Shuuji Ono, and Junichi Moriuma *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 65-68 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-21439*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE REALTIME OPERATIONS OF THE SPACE SHUTTLE ORBITER DURING RENDEZVOUS AND PROXIMITY OPERATIONS Abstract Only
Andrew Dougherty *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 30-31 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21449*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
SPACE SHUTTLE PROGRAM: AUTOMATIC RENDEZVOUS, PROXIMITY OPERATIONS, AND CAPTURE Abstract Only
William Jackson et al *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 39-40 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

N93-20305 Department of the Navy, Washington, DC.
MICRO-T TELEMETRY SYSTEM Patent
Larry L. Rollingson, inventor (to Navy), Richard G. Drake, inventor (to Navy), and Kenneth P. Lusk, inventor (to Navy) 20 Oct. 1992 6 p Filed 2 Aug. 1982
(AD-D015542; US-Patent-5,156,357; US-Patent-Appl-SN-406686) Avail: US Patent and Trademark Office

A small telemetry system for small diameter missiles uses a combined wrap around antenna, discrete circuit boards, and heat-sink bulkheads to achieve a small telemetry system to replace the payload on such missiles. GRA

N93-20445# National Space Development Agency, Ibaraki (Japan). Guidance and Control Lab.
RESEARCH ON HIGHLY FUNCTIONAL GUIDANCE AND CONTROL TECHNOLOGY [KOUKINOU YUUSOU SEIGYO GIJUTSU NO KENKYUU]
Shigehiro Mori, Hitoshi Mineno, Isao Kawano, Mamoru Fukui, Mitsuru Yamada, and Shingo Hirata *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 163-164 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N93-19988*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COLD-SAT DYNAMIC MODEL
Neil S. Adams (Analex Corp., Brook Park, OH.) and Gary Bollenbacher Dec. 1992 108 p
(RTOP 506-42-73)
(NASA-TM-105185; E-6483; NAS 1.15:105185) Avail: CASI HC A06/MF A02

This report discusses the development and underlying mathematics of a rigid-body computer model of a proposed cryogenic on-orbit liquid depot storage, acquisition, and transfer spacecraft (COLD-SAT). This model, referred to in this report as the COLD-SAT dynamic model, consists of both a trajectory model and an attitudinal model. All disturbance forces and torques expected to be significant for the actual COLD-SAT spacecraft are modeled to the required degree of accuracy. Control and experimental thrusters are modeled, as well as fluid slosh. The model also computes microgravity disturbance accelerations at any specified point in the spacecraft. The model was developed by using the Boeing EASY5 dynamic analysis package and will run on Apollo, Cray, and other computing platforms. Author

N93-20042*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

PRE-INTEGRATED TRUSS SPACE STATION AND METHOD OF ASSEMBLY Patent Application

Timothy E. Pelischek, inventor (to NASA), Edgar O. Castro, inventor (to NASA), Gregg A. Edeen, inventor (to NASA), David A. Hamilton, inventor (to NASA), Jon B. Kahn, inventor (to NASA), James B. McDede, inventor (to NASA), Kornel Nagy, inventor (to NASA), John V. Rivers, inventor (to NASA), Irene E. Verinder, inventor (to NASA), and Donald C. Wade, inventor (to NASA) et al 24 Dec. 1992 23 p

(NASA-Case-MSC-22015-1; NAS 1.71:MSC-22015-1; US-Patent-Appl-SN-996763) Avail: CASI HC A03/MF A01

The present invention is directed to methods and apparatus relating to design, construction, integration and assembly of a space station. The present invention uses pre-integrated open (unpressurized) truss segments for modular construction of the space station. Each segment includes a truss structure and utility subsystem which may be fully assembled and tested on Earth. The segments may be latched together on orbit using a remote latching system. Utility subsystems, such as solar panels and radiators, are pre-integrated into the appropriate truss segment, and are deployable from the respective truss segment on orbit. Rails run lengthwise along the assembled truss. The rails may be used with a mobile transporter for translating truss segments with respect to the spacecraft as part of the space station assembly process. The rails may also be used with a mobile transporter for carrying crew personnel, a robotic arm, and other equipment. With the present invention, the EVA time required for assembly as Space Station Freedom is markedly reduced. NASA

N93-20129# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

AN ELECTROMAGNETICALLY-CONTROLLED PRECISION ORBITAL TRACKING VEHICLE (POTV) M.S. Thesis

Richard E. Lawrence, Jr. Dec. 1992 142 p

(AD-A259143; AFIT/GA/ENY/92D-05) Avail: CASI HC A07/MF A02

A propulsion configuration is defined for a precision orbital tracking vehicle (POTV) that employs electrodynamic forces to control vehicle attitude and position with respect to another spacecraft. A pair of electrically powered thrusters assist the POTV in position control. The vehicle can maintain continuous standoff at close range from another spacecraft in any direction, has docking capability, and has gross orbital transfer capability. These capabilities and the specific design derived for the POTV have been defined by the requirements of a postulated space facility (ASSET) that salvages structural aluminum from the external fuel tank of the space shuttle. Precision control of the POTV is achieved by an electrical conductor configuration that makes current-produced thrust continuously available for independent control of components of vehicle attitude and translation. A robust tracking controller is designed that guarantees stability and compensates for modeling error. GRA

N93-20167# Old Dominion Univ., Norfolk, VA.

DESIGN CONSIDERATIONS FOR AN ASTRONAUT MONORAIL SYSTEM FOR LARGE SPACE STRUCTURES AND THE STRUCTURAL CHARACTERIZATION OF ITS POSITIONING ARM M.S. Thesis

Judith J. Watson Aug. 1992 175 p

Avail: CASI HC A08/MF A02

An astronaut monorail system (AMS) is presented as a vehicle to transport and position EVA astronauts along large space truss structures. The AMS is proposed specifically as an alternative to the crew and equipment transfer aid for Space Station Freedom. Design considerations for the AMS were discussed and a reference configuration was selected for the study. Equations were developed to characterize the stiffness and frequency behavior of the AMS positioning arm. Experimental data showed that these equations gave a fairly accurate representation of the stiffness and frequency behavior of the arm. A study was presented to show trends for the arm behavior based on varying parameters of the stiffness and frequency equations. An ergonomics study was conducted to provide boundary conditions for tolerable frequency and deflection to be used in developing a design concept for the positioning arm. The feasibility of the AMS positioning arm was examined using equations and working curves developed in this study. It was found that a positioning arm of a length to reach all interior points of the space station truss structure could not be designed to satisfy frequency and deflection constraints. By relaxing the design requirements and the ergonomic boundaries, an arm could be designed which would provide a stable work platform for the EVA astronaut and give him access to over 75 percent of the truss interior. Author

N93-20324# Air Force Inst. of Tech., Wright-Patterson AFB, OH.

EFFECTS OF MATERIAL DEGRADATION ON LARGE SPACE STRUCTURES DYNAMIC RESPONSE M.S. Thesis

Alan J. Perdigao Aug. 1992 243 p

(AD-A258574; AFIT/CI/CIA-92-103) Avail: CASI HC A11/MF A03

Composite Large Space Structures (LSS) including booms, planar surfaces, antennas, platforms, and space stations are proposed for use in NASA's Space Station 'Freedom' and the DOD's Global Protection Against Limited Strikes programs. Because of their low mass and high strength and stiffness, composite repetitive lattice structures are ideal for these space applications. LSS will be required to sustain severe environmental effects - radiation, thermal cycling, atomic oxygen bombardment, collision with micrometeoroids and space debris, and hostile actions - and transient operational loads - docking, slewing, manned activities, control system, and the mobile service center - while maintaining strict mission parameters. Platform pointing is one example of these requirements and necessitates tolerances of less than one thousandth of a degree. Over time, material and structural degradation will occur due to environmental effects causing a change in the structure's stiffness and dynamic response. Likely, this structural damage will require immediate repair to restore the LSS to full mission capability. This thesis investigates the dynamic response of one LSS - the NASA Dual-Keel Space Station with 5 meter graphite epoxy erectable truss under one operational load - shuttle docking - and Low Earth Orbit (LEO) environmental conditions, and predicts how the material, structural properties, and dynamic response change over the 20-30 year design life. Results show the effects of material degradation on the station's dynamic response and mission requirements and has applications for NASA and DOD logistics planning for future LSS. GRA

N93-20364# McDonnell-Douglas Astronautics Co., Huntington Beach, CA. Design and Technology Center.

SPACECRAFT INTERACTION WITH AMBIENT AND SELF-GENERATED PLASMA/NEUTRAL ENVIRONMENT Final Report, 1 Jul. 1990 - 31 Aug. 1992

Torkil S. Mogstad 31 Aug. 1992 104 p

(Contract F49620-90-C-0051)

(AD-A258647; AFOSR-92-0957TR) Avail: CASI HC A06/MF A02

This report presents the results of our study of Spacecraft Interaction with Ambient and Self-Generated Plasma/Neutral Environment. Various neutral effluent release scenarios in low Earth orbit were defined and modeled with direct simulation Monte Carlo (DSMC) methods. The simulated environments included H2 venting from an SDI-type chemical power system, and Space Station Freedom (SSF) mono and bipropellant hydrazine thruster plume distributions at high-voltage solar arrays. After the neutral distributions were characterized, various ionization mechanisms (charge exchange, critical velocity ionization effects, photo-ionization) were included to determine the local plasma production. Neutral and ion continuity equations were solved to obtain the local ion distribution in the vicinity of high-voltage surfaces. It was shown that the thruster effluents can generate self-induced neutral and plasma density distributions several orders of magnitude greater than the natural ambient environment. For a bipropellant MMH-N204 thruster firing into the ram, our simulations indicate that the local plasma density may increase as much as four orders of magnitude over the ambient. The effects of these self-induced environments on high-voltage surface arcing were assessed by using a microscopic model of the arcing process developed at MIT. High-voltage surface arcing thresholds, probabilities, and frequencies for current and future space platforms were discussed. GRA

N93-20380# Panametrics, Inc., Waltham, MA.

DEVELOPMENT AND USE OF DATA ANALYSIS PROCEDURES FOR THE CRRES PAYLOADS AFGL-701-2/DOSIMETER AND AFGL-701-4/FLUXMETER AND APPLICATION OF THE DATA ANALYSIS RESULTS TO IMPROVE THE STATIC AND DYNAMIC MODELS OF THE EARTH'S RADIATION BELTS Final Report, Jul. 1987 - Aug. 1992

Bronislaw K. Dichter and Frederick A. Hanser 17 Aug. 1992 28 p

(Contract F19628-87-C-0169)

(AD-A258710; AD-E201295; PL-TR-92-2223) Avail: CASI HC A03/MF A01

Response of the High Energy Electron Fluxmeter (instrument S/N 002) to electrons with energies between 1 and 4 MeV, as a function of instrument temperature, is described. GRA

N93-20382# RADEX, Inc., Bedford, MA.
SIMULATION AND CALCULATION OF THE APEX ATTITUDE Report No. 11
W. J. McNeil 29 Jul. 1992 54 p
(Contract F19628-89-C-0068)
(AD-A258716; AD-E201294; PL-TR-92-2209; RXR-92072) Avail: CASI HC A04/MF A01

A simulation of the APEX attitude is carried out for purposes of development and testing of attitude computation algorithms and for assessment of the accuracy of post-flight attitude determination. It is found that reasonably tractable algorithms give adequate accuracy for determination of attitude control in the vehicle. Sun normal angle will be known to a high precision during sunlit operations. The roll axis in sunlight and the three axes during eclipse will be somewhat less precise, depending mainly on the degree of magnetic contamination. However, it is estimated that these quantities will be of sufficient accuracy as well. GRA

N93-20922*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
NEUTRAL BUOYANCY TEST EVALUATION OF HARDWARE AND EXTRAVEHICULAR ACTIVITY PROCEDURES FOR ON-ORBIT ASSEMBLY OF A 14 METER PRECISION REFLECTOR
Walter L. Heard, Jr. and Mark S. Lake Feb. 1993 21 p
(RTOP 506-43-41-02)
(NASA-TM-107735; NAS 1.15:107735) Avail: CASI HC A03/MF A01

A procedure that enables astronauts in extravehicular activity (EVA) to perform efficient on-orbit assembly of large paraboloidal precision reflectors is presented. The procedure and associated hardware are verified in simulated Og (neutral buoyancy) assembly tests of a 14 m diameter precision reflector mockup. The test article represents a precision reflector having a reflective surface which is segmented into 37 individual panels. The panels are supported on a doubly curved tetrahedral truss consisting of 315 struts. The entire truss and seven reflector panels were assembled in three hours and seven minutes by two pressure-suited test subjects. The average time to attach a panel was two minutes and three seconds. These efficient assembly times were achieved because all hardware and assembly procedures were designed to be compatible with EVA assembly capabilities. Author

N93-20934# Aerospatiale, Paris (France).
THE DESIGN OF BONDED STRUCTURAL ASSEMBLIES [CONCEPTION DES ASSEMBLAGES STRUCTURAUX COLLES]
J. P. Maigret (Aerospatiale Aquitaine, Saint-Medard en Jalles, France.) 1992 13 p In FRENCH
(Rept-921-430-116; ETN-93-91944) Avail: CASI HC A03/MF A01

The high level of reliability and thermochemical requirements of space structures implies a great rigor in studies development. Structural assemblies are critical points and hence are treated with great care. In the case of bonded assemblies each step of the study to show the main characters and difficulties which occur to the designer are studied. An analysis shows that the help of an expert system associated with other means of processing calculations is necessary. The expert system ACLICO which is used during the first design study of bonded assemblies to set the specifications, the feasibility and the adhesives selection, is described. ESA

N93-20999*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SATELLITE SITUATION REPORT, VOLUME 32, NO. 4
31 Dec. 1992 369 p
(NASA-TM-108203; NAS 1.15:108203) Avail: CASI HC A16/MF A03

This report consists of data computed at the U.S. Space Command, GSFC, or provided by satellite owners. A space objects box score table is presented with data under the following headings: source/organization, objects in orbit, and decayed objects. The objects in orbit and decayed objects headings have payload, debris, and total as subheadings. The bulk of the document is objects-in-orbit tables with data under the following headings: international designation, name, catalog number, source, launch date, period minutes, inclination, apogee (km), perigee (km), and notes. CASI

N93-21003*# Ithaco, Inc., Ithaca, NY.
LOW COST ATTITUDE CONTROL SYSTEM SCANWHEEL DEVELOPMENT Final Report
William Bialke and Vaughn Selby 25 Mar. 1991 101 p
(Contract NAS5-30088)
(NASA-CR-191324; NAS 1.26:191324; Rept-94047) Avail: CASI HC A06/MF A02

In order to satisfy a growing demand for low cost attitude control systems for small spacecraft, development of low cost scanning horizon sensor coupled to a low cost/low power consumption Reaction Wheel Assembly was initiated. This report addresses the details of the versatile design resulting from this effort. Tradeoff analyses for each of the major components are included, as well as test data from an engineering prototype of the hardware. Author

N93-21042# Aerospatiale, Paris (France).
STRUCTURES AND MATERIALS TECHNOLOGIES FOR HYPERSONIC VEHICLES: LESSONS FROM HERMES EXPERIENCE
J. F. Jamet, D. Chaumette (Avions Marcel Dassault-Breguet Aviation, Saint-Cloud, France.), M. Desnoyers (Societe Europeenne de Propulsion, Vernon, France.), and P. Costa (Office National d'Etudes et de Recherches Aerospatiales, Paris, France.) 1992 13 p
(Rept-921-430-108; ETN-93-91936) Avail: CASI HC A03/MF A01

The thermal protection system of Hermes is a very important and complex system, specific to reentry vehicles. Intensive studies have been conducted on the development of materials and structures concepts, mainly on innovative ways to meet the specific requirements of the system. Recent results are presented and the possible reuse and extension of the acquired experience to an aerospace plane is analyzed. ESA

N93-21048# Sydney Univ. (Australia). School of Civil and Mining Engineering.
VARIANCE-COVARIANCE ESTIMATION AND STATISTICAL TESTING OF SATELLITE NETWORKS
N. Ananga, R. Coleman, and C. Rizos Aug. 1991 41 p
(PB92-225358; R-643) Avail: CASI HC A03/MF A01

Variance-covariance estimates for satellite networks are estimated for single-session solutions and also for the signal components of the control points. The combination of these two estimates form an efficient expression for a simultaneous network adjustment for satellite networks. The second part deals with the statistical analysis of the residuals using analysis of variance test and hypothesis test in least-squares collocation. The analysis of variance test depends on the discrepancies within each session of independently observed baselines and the discrepancies between the session of independently observed baselines. An independent test of the multi-session network adjustment was applied using least squares collocation. Here, the applications of the hypothesis tests to the estimated parameters, signals, and covariance functions are discussed. A numerical example using the Bass Strait survey is demonstrated. GRA

N93-21644*# Research Inst. for Computing and Information Systems, Houston, TX.
ROBUST ON-OFF PULSE CONTROL OF FLEXIBLE SPACE VEHICLES Final Technical Report
Bong Wie (Arizona State Univ., Tempe.) and Ravi Sinha (Arizona State Univ., Tempe.) 12 Jan. 1993 122 p
(Contract NCC9-16; RICIS Proj. MS-05)
(NASA-CR-192174; NAS 1.26:192174) Avail: CASI HC A06/MF A02

The on-off reaction jet control system is often used for attitude and orbital maneuvering of various spacecraft. Future space vehicles such as the orbital transfer vehicles, orbital maneuvering vehicles, and space station will extensively use reaction jets for orbital maneuvering and attitude stabilization. The proposed robust fuel- and time-optimal control algorithm is used for a three-mass spacing model of flexible spacecraft. A fuel-efficient on-off control logic is developed for robust rest-to-rest maneuver of a flexible vehicle with minimum excitation of structural modes. The first part of this report is concerned with the problem of selecting a proper pair of jets for practical trade-offs among the maneuvering time, fuel consumption,

structural mode excitation, and performance robustness. A time-optimal control problem subject to parameter robustness constraints is formulated and solved. The second part of this report deals with obtaining parameter insensitive fuel- and time- optimal control inputs by solving a constrained optimization problem subject to robustness constraints. It is shown that sensitivity to modeling errors can be significantly reduced by the proposed, robustified open-loop control approach. The final part of this report deals with sliding mode control design for uncertain flexible structures. The benchmark problem of a flexible structure is used as an example for the feedback sliding mode controller design with bounded control inputs and robustness to parameter variations is investigated. Author

N93-21702# General Electric Co., Philadelphia, PA. Astro Space Div.
GPHS-RTGs IN SUPPORT OF THE CASSINI MISSION Progress Report, 30 Mar. - 27 Sep. 1992
1992 37 p
(Contract DE-AC03-91SF-18852)
(DE93-002035; DOE/SF-18852/T19) Avail: CASI HC A03/MF A01

The technical progress achieved during the period 30 Mar. - 27 Sep. 1992 is described. Topics covered include: spacecraft integration and liaison; engineering support; safety; qualified unicouple production, ETG fabrication, assembly, and test; ground support equipment; radioisotope thermoelectric generators (RTG) shipping and launch support; designs, reviews, and mission applications; project management, quality assurance, reliability, contract changes, non-capital contractor acquired government owned (CAGO) acquisitions, and CAGO maintenance; and CAGO acquisitions. DOE

N93-20204*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
FIRE SAFETY PRACTICES IN THE SHUTTLE AND THE SPACE STATION FREEDOM
Robert Friedman *In its* The Second International Microgravity Combustion Workshop Feb. 1993 p 213-225 (For primary document see N93-20178 07-29)
Avail: CASI HC A03/MF A03; 11 functional color pages

N93-20411# National Space Development Agency, Ibaraki (Japan). Launch Vehicle and Satellite System Lab.
RESEARCH ON ADVANCED SPACECRAFT [SHOURAI NO UCHUUKI SHISUTEMU NO KENKYUU]
Tsutomu Iwata, Takao Etou, Ryouichi Imai, Kazuo Oota, Yutaka Kaneko, Toshihide Maeda, and Yutaka Takano *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 1-4 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20415# National Space Development Agency, Ibaraki (Japan). Total System Analysis Lab.
RESEARCH ON EARTH OBSERVING SATELLITE SYSTEM: CONCEPTUAL STUDY OF ADVANCED EARTH OBSERVING SATELLITE-2 (ADEOS-2) Report No. 1 [CHIKYUU KANSOKU EISEI SHISUTEMU NO KENKYUU: CHIKYUU KANSOKU GIJUTSU EISEI (ADEOS-2) GAINEN SEKKEI]
Yoshiaki Suzuki, Toshio Douura, Atsuo Tsuiki, and Tetsuya Kodama *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 19-24 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A02/MF A03

N93-20425# National Space Development Agency, Ibaraki (Japan). Total System Analysis Lab.
HOPE INFORMATION SYSTEM REVIEW [HOPE JOUHOU SHISUTEMU NO KENTOU]
Yoshiaki Suzuki, Kenji Nishiyama, Shuuji Ono, and Kouin Fukuda *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 69-72 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20426# National Space Development Agency, Ibaraki (Japan). Thermal and Structural Engineering Lab.
RESEARCH ON HEAT-RESISTANCE TECHNOLOGY FOR HOPE [HOPE YOU TAINETSU KOUZOU GIJUTSU NO KENKYUU]
Yoshiki Morino, Mamoru Ishikawa, Toshinari Yoshinaka, Hirobumi Tamura, and Youichi Satou *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 73-78 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A02/MF A03

N93-20428# National Space Development Agency, Ibaraki (Japan). Guidance and Control Lab.
RESEARCH ON COMBINED HOPE NAVIGATION TECHNOLOGY [HOPE FUKUGOU KOUHOU GIJUTSU NO KENKYUU]
Hideto Suzuki, Hitoshi Mineno, Shigehiro Mori, Isao Kawano, Shuuichi Matsumoto, and Shingo Hirata *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 85-88 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20432# National Space Development Agency, Ibaraki (Japan). Launch Vehicle and Satellite System Lab.
ORBIT RE-ENTRY EXPERIMENT VEHICLE DEVELOPMENT [KIDOU SAITOTSUNYUU JIKKENKI NO KAIHATSU]
Masataka Yamamoto, Kouji Yamawaki, Toshio Akimoto, Atsushi Murakami, Motoyuki Inaba, Yutaka Kaneko, Takayuki Shimoda, Yasuo Ishii, Tatsushi Izumi, and Isao Kawano et al *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 103-110 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A02/MF A03

N93-20433# National Space Development Agency, Ibaraki (Japan). Thermal and Structural Engineering Lab.
DEVELOPMENT AND TESTS ON OREX VEHICLE THERMAL STRUCTURE SYSTEM [KIDOU SAITOTSUNYUU JIKKENKI NETSU KOUZOUKEI KAIHATSU SHIKEN OYOBI SONO SEIKA]
Toshinari Yoshinaka and Yoshiki Morino *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 111-116 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A02/MF A03

N93-20437# National Space Development Agency, Ibaraki (Japan). Total System Analysis Lab.
CONCEPTUAL STUDY OF ETS-7 Report No. 2 [ETS-7 NO GAINEN SEKKEI]
Takao Anzai, Mitsushige Oda, Yasufumi Wakabayashi, and Ryouichi Imai *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 129-132 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20438# National Space Development Agency, Ibaraki (Japan). Guidance and Control Lab.
RESEARCH ON RENDEZVOUS AND DOCKING TECHNOLOGY [RANDEBU DOKKINGU GIJUTSU NO KENKYUU]
Shinichirou Ichikawa, Isao Kawano, Hiroyuki Suzuki, and Mitsuru Yamada *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 133-136 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20439# National Space Development Agency, Ibaraki (Japan). Thermal and Structural Engineering Lab.
RESEARCH ON DOCKING MECHANISM SYSTEM TEST Report No. 2 [DOKKINGU KIKOU SHISUTEMU SHIKEN NO KENKYUU]
Yoshiki Morino, Haruaki Itagaki, and Shigeto Shibuta *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 137-140 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20443# National Space Development Agency, Ibaraki (Japan). Thermal and Structural Engineering Lab.
RESEARCH ON SPACE STRUCTURE MATERIALS [UCHUUYOU KOUZOU ZAIRYOU NO KENKYUU]
Kouzou Yudate, Shigeto Shibuta, and Yoshiki Morino *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 155-158 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20444# National Space Development Agency, Ibaraki (Japan). Thermal and Structural Engineering Lab.
RESEARCH ON LARGE STRUCTURE ASSEMBLY TECHNOLOGY: RESEARCH ON DEPLOYABLE ASSEMBLY STRUCTURE Report No. 3 [OOGATA KOUZOUBUTSU KUMITATE GIJUTSU NO KENKYUU: TENKAI KUMITATE KOUZOU NO KENKYUU]
Yoshiki Morino and Shigeto Shibuta *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 159-162 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20450# National Space Development Agency, Ibaraki (Japan). Common Equipment Lab.
SPACE ENVIRONMENT MODEL CONSTRUCTION TECHNOLOGY [UCHUU KANKYOU MODERU NO SEIBI GIJUTSU]
Hironobu Nishimoto and Haruhisa Matsumoto *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 183-186 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20452# National Space Development Agency, Ibaraki (Japan). Environmental and Structural Test Dept.
RESEARCH ON ADVANCED SPACECRAFT TESTING TECHNOLOGY [SHOURAI UCHUUKI NO SHIKEN GIJUTSU NI KANSURU KENKYUU]
Takeshi Matsuoka, Chikashi Sasamura, and Tetsuya Inagaki *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 191-194 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20454# National Space Development Agency, Ibaraki (Japan). First Operations Div.
EVALUATION AND ANALYSIS OF LONG TERM SATELLITE OPERATION DATA [JINKOU EISEI CHOUKI UNYOU DETA NO HYOUKA KAISEKI]
Shuuji Naitou, Hirohito Sarai, Masakatsu Yamawaki, Ryouichi Anzai, Eiichi Koyama, and Ryouji Kobayashi *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 201-204 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20455# National Space Development Agency, Ibaraki (Japan). First Operations Div.
OPERATIONAL SUPPORT FOR ETS-5 SECONDARY OPERATIONAL PHASE [ETS-5 NO KOUKI DANKAI NO UNYOU SHIEN]
Susumu Wakabayashi, Shinji Kawano, and Masakatsu Yamawaki *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 205-208 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20480# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.
REVIEW ON PARTS TEST DATA ANALYZING SYSTEM [BUHIN SHIKEN DETA KAISEKI SHISUTEMU NO KENTOU]
Takashi Tamura, Masato Uesugi, and Kouichi Suzuki *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 299-302 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20488# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.
REVIEW ON SAFETY VALIDATION TEST [ANZENSEI JISSHOU SHIKEN NI KANSURU KENTOU]
Tadaaki Kurosaki and Takashi Watanabe *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 331-334 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20726# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
SOME OBSERVATIONS OF CHAOTIC MOTION OF SATELLITES WITH DAMPING IN AN ELLIPTIC ORBIT
X. Tong and F. P. J. Rimrott *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 750-751 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-21411*# TRW, Inc., Redondo Beach, CA. Federal System Div.
CONTACT DYNAMICS TESTING OF AUTOMATED THREE-POINT DOCKING MECHANISM Abstract Only
Kenneth H. Rourke *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 7 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21412*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
TRAC BASED SENSING FOR AUTONOMOUS RENDEZVOUS Abstract Only
Louis J. Everett (Texas A&M Univ., College Station.) and Leo Monford *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 7-8 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21415*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
THRUSTER CONFIGURATIONS FOR MANEUVERING HEAVY PAYLOADS Abstract Only
Roy K. Tsugawa (TRW, Inc., Redondo Beach, CA.), Michael E. Draznin (TRW, Inc., Redondo Beach, CA.), and Richard W. Dabney *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 9-10 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21418*# Lockheed Engineering and Sciences Co., Houston, TX.
AUTONOMOUS PRE-ALIGNMENT OF A DOCKING MECHANISM Abstract Only
Monty B. Carroll and John A. Thompson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 12 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21420*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
A BERTHING AND FASTENING STRATEGY FOR ORBITAL REPLACEMENT UNITS Abstract Only
John Vranish and Edward Cheung *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 13-14 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21423*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
DEMONSTRATION OF AUTOMATED PROXIMITY AND DOCKING TECHNOLOGIES Abstract Only
Robert L. Anderson (TRW, Inc., Redondo Beach, CA.), Roy K. Tsugawa (TRW, Inc., Redondo Beach, CA.), and Thomas C. Bryan *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 16 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21427*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
AUTONOMOUS RENDEZVOUS AND CAPTURE SYSTEM DESIGN Abstract Only
Richard Dabney *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 19-20 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21428*# McDonnell-Douglas Space Systems Co., Houston, TX.
PROXIMITY OPERATIONS CONSIDERATIONS AFFECTING SPACECRAFT DESIGN Abstract Only
Steven K. Staas *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 21 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21429*# Martin Marietta Corp., Denver, CO. Civil Space and Communications Div.
GUIDELINE REQUIREMENTS FOR SERVICEABLE SPACECRAFT GRASPING/BERTHING/DOCKING INTERFACES BASED ON SIMULATIONS AND FLIGHT EXPERIENCE Abstract Only
Allen B. Thompson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 21 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21430*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
AUTONOMOUS DOCKING GROUND DEMONSTRATION Abstract Only
Steve L. Lamkin, Thomas Quan Le, L. T. Othon, Joseph L. Prather, Richard E. Eick (TRW, Inc., Houston, TX.), Jim M. Baxter (TRW, Inc., Houston, TX.), M. G. Boyd (Lockheed Engineering and Sciences Co., Houston, TX.), Fred D. Clark (Lockheed Engineering and Sciences Co., Houston, TX.), Peter T. Spehar (Lockheed Engineering and Sciences Co., Houston, TX.), and Rebecca T. Teters (Lockheed Engineering and Sciences Co., Houston, TX.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 21-22 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21431*# General Dynamics Corp., San Diego, CA. Space Systems Div.
AN OVERVIEW OF AUTONOMOUS RENDEZVOUS AND DOCKING SYSTEM TECHNOLOGY DEVELOPMENT Abstract Only
Kurt D. Nelson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 22-23 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21432*# General Dynamics Corp., San Diego, CA. Space Systems Div.
AN AUTONOMOUS RENDEZVOUS AND DOCKING SYSTEM USING CRUISE MISSILE TECHNOLOGY Abstract Only
Ed Jones and Bruce Nicholson *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 23-24 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21433*# Fairchild Space Co., Germantown, MD.
ON-ORBIT DEMONSTRATIONS OF AUTOMATED CLOSURE AND CAPTURE USING ESA-DEVELOPED PROXIMITY OPERATIONS TECHNOLOGIES AND AN EXISTING SERVICEABLE NASA EXPLORER PLATFORM SPACECRAFT Abstract Only
Bill Hohweisner and Jean-Michael Pairot (MATRA Marconi Space, Toulouse, France.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 24-25 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21435*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
A PHASE ONE AR/C SYSTEM DESIGN Abstract Only
Peter M. Kachmar (Draper, Charles Stark Lab., Inc., Cambridge, MA.), Robert J. Polutchko (Draper, Charles Stark Lab., Inc., Cambridge, MA.), Martin Matusky (Draper, Charles Stark Lab., Inc., Cambridge, MA.), William Chu (Draper, Charles Stark Lab., Inc., Cambridge, MA.), William Jackson, and Moises Montez *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 26-27 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21437*# TRW, Inc., Redondo Beach, CA. Federal Systems Div.
COLLISION AVOIDANCE FOR CTV: REQUIREMENTS AND CAPABILITIES Abstract Only
Thomas Nosek and Kenneth Rourke *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 28 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21438*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
MMU APPLICATIONS FOR AUTOMATED RENDEZVOUS AND CAPTURE Abstract Only
Edward Whitsett *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 28-30 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21440*# National Aeronautics and Space Administration, Washington, DC.
AUTONOMOUS RENDEZVOUS AND DOCKING: A COMMERCIAL APPROACH TO ON-ORBIT TECHNOLOGY VALIDATION Abstract Only
Peter Tchoryk, Jr. (Environmental Research Inst. of Michigan, Ann Arbor.) and Raymond P. Whitten et al *In its* NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 31-32 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21443*# Lockheed Engineering and Sciences Co., Houston, TX.
SIX-DEGREE-OF-FREEDOM TEST FACILITY Abstract Only
Michelle A. Bittel *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 34 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21444*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SOVIET AUTOMATED RENDEZVOUS AND DOCKING SYSTEM OVERVIEW Abstract Only
Elaine M. Hinman and David M. Bushman *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 34-35 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21445*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SUPERVISED AUTONOMOUS RENDEZVOUS AND DOCKING SYSTEM TECHNOLOGY EVALUATION Abstract Only
Neville I. Marzwell *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 35-36 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21446*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
AUTONOMOUS RENDEZVOUS AND CAPTURE DEVELOPMENT INFRASTRUCTURE Abstract Only
Thomas C. Bryan et al *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 36-37 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21448*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
NASA MSFC HARDWARE IN THE LOOP SIMULATIONS OF AUTOMATIC RENDEZVOUS AND CAPTURE SYSTEMS Abstract Only
Patrick A. Tobbe (Logicon Control Dynamics Co., Huntsville, AL.), Charles B. Naumann (Logicon Control Dynamics Co., Huntsville, AL.), William Sutton, and Thomas C. Bryan *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 38-39 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N93-21777# Los Alamos National Lab., NM.
A SEMI-CUSTOM DUAL CHANNEL PEAK HOLD CIRCUIT FOR SPACEBORNE INSTRUMENTATION
M. R. Sweet and K. M. Grace 1992 5 p Presented at the Institute Electrical and Electronic Engineers (IEEE) Meeting, Orlando, FL, 26-30 Oct. 1992
(Contract W-7405-eng-36)
(DE93-003801; LA-UR-92-3603; CONF-9210232-3) Avail: CASI HC A01/MF A01

A monolithic dual channel peak hold circuit is developed using a semi-custom Application Specific Integrated Circuit (ASIC). The circuit is designed specifically for spaceborne instrumentation that requires low power operation and low mass packaging. Each independent circuit holds positive pulses and consists of a differential transconductance amplifier followed by a one way current amplifier. Input gate and output hold functions are enabled by standard TTL or CMOS logic levels. To accommodate a range of applications, quiescent power is adjustable for performance-power tradeoff or can be disabled for single channel use. Fabricated with dielectrically isolated vertical geometry NPN and PNP transistors, the circuit is inherently radiation-hard and immune to transient upset. DOE

N93-21823*# Aura Systems, Inc., Los Angeles, CA.
THE GALILEO PPS EXPERT MONITORING AND DIAGNOSTIC PROTOTYPE Final Report
Khosrow Bahrami 30 Jan. 1989 22 p
(Contract JPL-958346)
(NASA-CR-191914; NAS 1.26:191914) Avail: CASI HC A03/MF A01

The Galileo PPS Expert Monitoring Module (EMM) is a prototype system implemented on the SUN workstation that will demonstrate a knowledge-based approach to monitoring and diagnosis for the Galileo spacecraft Power/Pyro subsystems. The prototype will simulate an analysis module functioning within the SFOC Engineering Analysis Subsystem Environment (EASE). This document describes the implementation of a prototype EMM for the Galileo spacecraft Power Pyro Subsystem. Section 2 of this document provides an overview of the issues in monitoring and diagnosis and comparison between traditional and knowledge-based solutions to this problem. Section 3 describes various tradeoffs which must be considered when designing a knowledge-based approach to monitoring and diagnosis, and section 4 discusses how these issues were resolved in constructing the prototype. Section 5 presents conclusions and recommendations for constructing a full-scale demonstration of the EMM. A Glossary provides definitions of terms used in this text.
Derived from text

N93-20416# National Space Development Agency, Ibaraki (Japan). Specific Equipment Lab.
RESEARCH ON ADVANCED EARTH OBSERVING SENSORS [SHOURAIGATA CHIKYUU KANSOKU SENSA NO KENKYUU]
Takashi Noguchi, Yuuji Oosawa, Masakatsu Nakajima, Toshihiro Sezai, and Akira Furusawa *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 25-32 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A02/MF A03

N93-20417# National Space Development Agency, Ibaraki (Japan). Specific Equipment Lab.
IRCCD RESEARCH Report No. 6 and 7 [IRCCD NO KENKYUU]
Takashi Noguchi, Masakatsu Nakajima, and Akira Furusawa *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 33-38 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A02/MF A03

N93-20436# National Space Development Agency, Ibaraki (Japan). Guidance and Control Lab.
RESEARCH ON EQUIPMENT LIFE EXTENSION TECHNOLOGY [KIKI NO CHOUJUMYOUKA GIJUTSU NO KENKYUU]
Shigehiro Mori and Shingo Hirata *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 125-128 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-21414*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
TRAJECTORY CONTROL SENSOR ENGINEERING MODEL DETAILED TEST OBJECTIVE Abstract Only
Kent Dekome and Joseph Martin Barr (Lockheed Engineering and Sciences Co., Houston, TX.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 9 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N93-19991*# United Technologies Corp., West Palm Beach, FL. Pratt and Whitney.
ADVANCED EXPANDER TEST BED PROGRAM Annual Technical Progress Report, 1 Jan. - 31 Dec. 1992
D. P. Riccardi and J. C. Mitchell Jan. 1993 27 p Original contains color illustrations
(Contract NAS3-25960; RTOP 584-04-11)
(NASA-CR-191049; NAS 1.26:191049; FR-21319-3) Avail: CASI HC A03/MF A01; 1 functional color page

The Advanced Expander Test Bed (AETB) is a key element in NASA's Space Chemical Engine Technology Program for development and demonstration of expander cycle oxygen/hydrogen engine and advanced component technologies applicable to space engines as well as launch vehicle upper stage engines. The AETB will be used to validate the high-pressure expander cycle concept, investigate system interactions, and conduct investigations of advanced mission focused components and new health monitoring techniques in an engine system environment. The split expander cycle AETB will operate at combustion chamber pressures up to 1200 psia with propellant flow rates equivalent to 20,000 lbf vacuum thrust. Contract work began 27 Apr. 1990. During 1992, a major milestone was achieved with the review of the final design of the oxidizer turbopump in Sep. 1992. Author

N93-20064*# Rocket Research Corp., Redmond, WA. Olin Aerospace Div.
H2 ARCJET PERFORMANCE MAPPING PROGRAM Final Report, Mar. 1991 - Jan. 1992
31 Jan. 1992 51 p Prepared for Texas Technological Univ., Lubbock
(Grant NAG3-1172)
(NASA-CR-191073; NAS 1.26:191073; Rept-92-R-1615) Avail: CASI HC A04/MF A01

Work performed during the period of Mar. 1991 to Jan. 1992 is reviewed. High power H2 arcjets are being considered for electric powered orbit transfer vehicles (EOTV). Mission analyses indicate that the overall arcjet thrust efficiency is very important since increasing the efficiency increases the thrust, and thereby reduces the total trip time for the same

power. For example, increasing the thrust efficiency at the same specific impulse from 30 to 40 percent will reduce the trip time by 25 percent. For a 200 day mission, this equates to 50 days, which results in lower ground costs and less time during which the payload is dormant. Arcjet performance levels of 1200 seconds specific impulse (Isp) at 35 to 40 percent efficiency with lifetimes over 1000 hours are needed to support EOTV missions. Because of the potential very high efficiency levels, the objective of this program was to evaluate the ability of a scaled Giannini-style thruster to achieve the performance levels while operating at a reduced nominal power of 10 kW. To meet this objective, a review of past literature was conducted; scaling relationships were developed and applied to establish critical dimensions; a development thruster was designed with the aid of the plasma analysis model KARNAC and finite element thermal modeling; test hardware was fabricated; and a series of performance tests were conducted in RRC's Cell 11 vacuum chamber with its null-balance thrust stand. Derived from text

N93-20114*# GenCorp Aerojet, Sacramento, CA. Propulsion Div.
ADVANCED SMALL ROCKET CHAMBERS: OPTION 1, 14 lbf Ir-Re ROCKET Final Report
Donald M. Jassowski and Mark L. Gage Aug. 1992 231 p
(Contract NAS3-25646; RTOP 506-42-31)
(NASA-CR-191014; NAS 1.26:191014) Avail: CASI HC A11/MF A03

A high performance Ir-Re 14 lbf (62 N) chamber and nozzle which can be a direct replacement for a production engine was designed, built, hot fired and vibration acceptance tested. It passed all acceptance tests satisfactorily and demonstrated a 20 sec increase in specific impulse (Is) over the conventional 14 lbf silicide coated Cb chamber. The high performance engine uses the production valve and injector without modification. Incorporation of a secondary mixing device or Boundary Layer Trip within the combustion chamber results in elimination of the fuel film coolant, improvement in flow uniformity, the 20 sec performance increase, and reduction of a potential source of spacecraft contamination. Measured Is was 305 sec at 75:1 area ratio, with monomenthylhydrazine and nitrogen tetroxide propellants. Qualification tests remain to be done. Author

N93-20293# General Accounting Office, Washington, DC. National Security and International Affairs Div.
SPACE SHUTTLE: STATUS OF ADVANCED SOLID ROCKET MOTOR PROGRAM. REPORT TO THE CHAIR, SUBCOMMITTEE ON GOVERNMENT ACTIVITIES AND TRANSPORTATION, COMMITTEE ON GOVERNMENT OPERATIONS, HOUSE OF REPRESENTATIVES
17 Nov. 1992 21 p
(GAO/NSIAD-93-26; B-248285) Avail: CASI HC A03/MF A01; GAO, PO Box 6015, Gaithersburg, MD 20877 HC

The Advanced Solid Rocket Motor is one of the National Aeronautics and Space Administration's (NASA) most expensive and controversial programs. Two reusable solid rocket motors are attached to the Space Shuttle to provide most of the thrust needed to lift it into orbit. The advanced motor is being designed to replace the current motor, which is a redesigned version of the motor that caused the January 1986 Challenger accident. The Chair of the Subcommittee on Government Activities and Transportation, House Committee on Government Operations, requested that GAO review the program's status. The specific objectives were to: (1) assess the extent to which the need for the program has changed; and (2) determine the reasons for cost growth and schedule slippage. Author

N93-20614*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ATOMIC HYDROGEN PROPELLANTS: HISTORICAL PERSPECTIVES AND FUTURE POSSIBILITIES
Bryan Palaszewski Feb. 1993 25 p Presented at the Aerospace Sciences Meeting and Exhibit, Reno, NV, 11-14 Jan. 1993; sponsored by AIAA Previously announced in IAA as A93-24234
(RTOP 506-42-00)
(NASA-TM-106053; E-7646; NAS 1.15:106053) Avail: CASI HC A03/MF A01

Atomic hydrogen, a very high density free-radical propellant, is anticipated to generate a specific impulse of 600-1500 lb-f sec/lb-mass performance; this may facilitate the development of unique launch vehicles. A development status evaluation is presently given for atomic hydrogen investigations. It is noted that breakthroughs are required in the production, storage, and transfer of atomic hydrogen, before this fuel can become a viable rocket propellant. Author

N93-20615*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SPACE TRANSFER WITH GROUND-BASED LASER/ELECTRIC PROPULSION
Geoffrey A. Landis (Sverdrup Technology, Inc., Brook Park, OH.), Mark Stavnes (Sverdrup Technology, Inc., Brook Park, OH.), Steve Oleson (Sverdrup Technology, Inc., Brook Park, OH.), and John Bozek Jul. 1993 20 p Prepared for presentation at the 28th Joint Propulsion Conference and Exhibit, Monterey, CA, 28-30 Jun. 1993; sponsored by AIAA, SAE, ASME, and ASEE
(RTOP 506-46-11)
(NASA-TM-106060; E-7663; NAS 1.15:106060; AIAA Paper 92-3213)
Avail: CASI HC A03/MF A01

A new method of providing power to space vehicles consists of using ground-based lasers to beam power to photovoltaic receivers in space. This can be used as a power source for electrically propelled orbital transfer vehicles. Author

N93-20896*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Interdisciplinary Center for Applied Mathematics.
ADVANCED BOOSTER GUIDANCE STUDIES Final Report, 19 Dec. 1988 - 15 Aug. 1992
Eugene M. Cliff 1 Mar. 1993 33 p
(Grant NAG1-946)
(NASA-CR-192336; NAS 1.26:192336; ICAM-93-03-01) Avail: CASI HC A03/MF A01

This report is a summary of work done under Grant NAG1-946 for the period 19 December 1988 through 15 August 1992. Most of the technical work is described in the paper produced, including the NASA Contractor Report 4393 - 'Optimal Control Problems with Switching Points'. In the following pages we present a list of the papers along with a brief abstract. The technical work during the last months of the grant has not yet been submitted for publication so we present a summary of that work in an Appendix. Author

N93-20912*# Cruse (Thomas), Nashville, TN.
SRB FRUSTRUM 'SMILEY' CRACKING PHENOMENON STUDY Final Report, 17 Aug. 1992 - 15 Feb. 1993
Thomas A. Cruse 26 Feb. 1993 36 p Original contains color illustrations
(NASA Order H-11992-D)
(NASA-CR-192621; NAS 1.26:192621; TAC-93-001) Avail: CASI HC A03/MF A01; 3 functional color pages

The thermal protection system installed on the SRB frustrums incurs the formation of debonds between the MSA-2 TPS material and the substrate. The debonds can lead to surface penetrating cracks, called 'smileys' near sealed fasteners and other surface discontinuities. The study concluded that the 'smileys' were caused as the result of stress risers caused by excess fastener sealant (PR-1422) and weakly bonded surfaces. Once the debond occurs, 'smileys' form when the debond area is sufficiently large. The loading for the debond and 'smiley' formation is seen to be depressurization at the vacuum conditions near the end of powered boost. The porous nature of the MSA-2 material covered by a vapor barrier paint provides internal pressure loading of the MSA-2 material. Recommendations for eliminating the problem include elimination of excess PR-1422 sealant and improved attention to bonding surface preparation. Author

N93-21355*# Lockheed Missiles and Space Co., Sunnyvale, CA. Advanced Solid Rocket Motor Div.
ASRM PROCESS DEVELOPMENT IN AQUEOUS CLEANING
Bill Swisher 8 Dec. 1992 26 p Meeting of the JANNAF Interagency Committee, Rocket Nozzle Technology Sub-Committee, held in Sunnyvale, CA, 8-10 Dec. 1992
(Contract NAS8-37800)
(NASA-CR-191949; NAS 1.26:191949) Avail: CASI HC A03/MF A01

Viewgraphs are included on process development in aqueous cleaning which is taking place at the Aerojet Advanced Solid Rocket Motor (ASRM) Division under a NASA Marshall Space and Flight Center contract for

design, development, test, and evaluation of the ASRM including new production facilities. The ASRM will utilize aqueous cleaning in several manufacturing process steps to clean case segments, nozzle metal components, and igniter closures. ASRM manufacturing process development is underway, including agent selection, agent characterization, subscale process optimization, bonding verification, and scale-up validation. Process parameters are currently being tested for optimization utilizing a Taguci Matrix, including agent concentration, cleaning solution temperature, agitation and immersion time, rinse water amount and temperature, and use/non-use of drying air. Based on results of process development testing to date, several observations are offered: aqueous cleaning appears effective for steels and SermeTel-coated metals in ASRM processing; aqueous cleaning agents may stain and/or attack bare aluminum metals to various extents; aqueous cleaning appears unsuitable for thermal sprayed aluminum-coated steel; aqueous cleaning appears to adequately remove a wide range of contaminants from flat metal surfaces, but supplementary assistance may be needed to remove clumps of tenacious contaminants embedded in holes, etc.; and hot rinse water appears to be beneficial to aid in drying of bare steel and retarding oxidation rate. Author

N93-21460# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Moissy-Cramayel (France).

EVOLUTION OF MATERIALS USED IN LIQUID PROPELLANT ROCKET ENGINES [EVOLUTION DES MATERIAUX UTILISES EN PROPULSION FUSEE A ERGOLS LIQUIDES]

Paul Donguy and Jean-Michel deMonicault 1991 11 p In FRENCH Presented at AAAF 39th Salon International de Paris on Materiaux pour l'Aeronautique, Le Bourget, France, 14-23 Jun. 1991

(DS-2025; ETN-93-93394) Avail: CASI HC A03/MF A01

A schematic description of a rocket engine is given highlighting the needs of materials for such an application. The evolution of metallic materials from the HM7 engine used on the 3rd stage of Ariane 4, to the Vulcain engine for the central body of Ariane 5 is reviewed. The stresses of very low and very high temperatures as well as the particular environment (hydrogen-oxygen) are pointed out. The effect of the limitations of the metals on the rocket engine performance, principally in the maximal admissable temperature domain and the mass, are indicated. The advantages offered by ceramic matrix material composites with respect to maximal admissible temperatures and weight reduction are presented together with the gains hoped for with regard to the engine system. Three application domains are evoked divergent nozzles, combustion chambers, and the turbopump stators and turbines. ESA

N93-21645*# National Aeronautics and Space Administration, Washington, DC.

REPORT OF THE SSME ASSESSMENT TEAM

Jan. 1993 45 p

(NASA-TM-108217; NAS 1.15:108217) Avail: CASI HC A03/MF A01

In response to a request from the House of Representatives Committee on Science, Space, and Technology in its Report No. 102-500 of April 22, 1992, the Aerospace Safety Advisory Panel (ASAP) created an ad hoc task force to conduct a thorough assessment of the Space Shuttle Main Engine (SSME). The membership was drawn mostly from organizations other than ASAP, and this report represents the views of that task force. Its task was to assess the risk that the SSME poses to the safe operation of the Space Shuttle, to identify and evaluate improvements to the engine that would reduce the risk, and to recommend a set of priorities for the implementation of these improvements. The SSME Assessment Team, as it opted to call itself, convened in mid-1992 and, subsequently, met with and gathered information from all the principal organizations involved in the SSME program. These included the Rocketdyne Division of Rockwell International, the Marshall Space Flight Center of NASA, and the Pratt & Whitney Division of United Technologies Corporation. The information in this report reflects the program status as of October 1992. From the information received, the Team formed its conclusions and recommendations. Changes in the program status have, of course, occurred since that time; however, they did not affect the Team's conclusions and recommendations. Derived from text

N93-21728# Sandia National Labs., Albuquerque, NM.

NUCLEAR THERMAL ROCKET ENTRY HEATING AND THERMAL RESPONSE PRELIMINARY ANALYSIS

D. L. Potter, L. W. Connell, C. Channy Wong, and M. W. Kniskern 1992 6 p Presented at the 31st American Institute of Astronautics and Aeronautics (AIAA) Aerospace Sciences Meeting, Reno, NV, 11-14 Jan. 1993 Previously announced in IAA as A93-23058

(Contract DE-AC04-76DP-00789)

(DE93-002460; SAND-92-2342C; CONF-930108-2; AIAA-93-0378) Avail: CASI HC A02/MF A01

This preliminary study analyzes the atmospheric entry of a solid core nuclear thermal rocket (NTR) engine under three accidental entry scenarios. Depending on the scenario, results of the analysis showed that, without external thermal protection, an aluminum pressure vessel will fail at altitudes ranging 25 to 73 km.; subsequent release of the core materials occurs. The graphitic based core materials will undergo partial ablation, with the percent mass loss depending on the geometry of the fuel elements. A carbon-phenolic thermal protection system was sized to prevent pressure vessel aerothermal failure. It was found to increase the mass of the NTR by approximately 15 percent. DOE

N93-20141*# Aerojet Strategic Propulsion Co., Sacramento, CA. Advanced Solid Rocket Motor Div.

INTRODUCTION OF LASER INITIATION FOR THE 48-INCH ADVANCED SOLID ROCKET MOTOR (ASRM) TEST MOTORS AT MARSHALL SPACE FLIGHT CENTER (MSFC)

Chris J. Zimmerman and Gerald E. Litzinger *In* NASA. Stennis Space Center, The First NASA Aerospace Pyrotechnic Systems Workshop Jan. 1993 p 157-177 (For primary document see N93-20132 07-28)

Avail: CASI HC A03/MF A04

N93-20724# Bristol Aerospace Ltd., Winnipeg (Manitoba).

AN INVESTIGATION OF THE UNEXPECTED ATTITUDE DYNAMICS EXPERIENCED BY THE OEDIPUS-A TETHERED SOUNDING ROCKET PAYLOAD

G. Tye, R. P. S. Han (Manitoba Univ., Winnipeg.), and T. G. Berry (Manitoba Univ., Winnipeg.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 746-747 (For primary document see N93-20616 07-39)

Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

23 CHEMISTRY AND MATERIALS (GENERAL)

N93-20926# European Space Agency, Paris (France).

TOUCHSTONE FOR SUCCESS: THE MATERIALS AND PROCESSES LABORATORIES, ESTEC

Norman Longdon, ed. Apr. 1992 28 p Revised Original contains color illustrations

(ESA-BR-52-Rev; ETN-93-93040) Copyright Avail: CASI HC A03/MF A01

Pertinent questions and answers about the use of materials and process laboratories in space research are presented. These include the main generic problems tackled by these laboratories and methods of coping with the data accumulated. The main activities of the laboratories can be grouped under three main headings: environmental effects, metallic materials and processes, and nonmetallic materials and processes. The activities performed by these laboratories and the equipment used in them are described. ESA

N93-20815# Canadian Space Agency, Ottawa (Ontario). Space Station Program.

AN OVERVIEW OF SPACE QUALIFICATION REQUIREMENTS FOR NEW MATERIALS

David Madeley *In its* Protection of Materials and Surface Finishes from the Low Earth Orbit Space Environment 1992 12 p (For primary document see N93-20810 07-25)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3, HC

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

For ceramic materials see *27 Nonmetallic Materials.*

N93-19986# South Carolina Research Authority. Charleston.
PDES APPLICATION PROTOCOL SUITE FOR COMPOSITE (PAS-C). FUNCTIONAL NEEDS/STATE/OF-THE-ART COMPARISON FOR THE PAS-C PROGRAM Final Report, 15 Jul. 1991 - 15 Apr. 1992
Keith Hunten, Jon Judd, Ted Goosen, Floyd Ganus, and Dennis Biddle May 1992 115 p
(Contract F33615-91-C-5713)
(AD-A258613; PASC-009.01.00; WL-TR-92-8062) Avail: CASI HC A06/MF A02

The focus of this document is to refine the functional needs identified in Functional Needs IDEFO Activity and Information Needs for the PAS-C Program to correlate these composite part information exchange needs to resources in the PDES/STEP information models, and to prioritize the addressing of the voids identified during the comparison. The comparisons and prioritization provide insight into the breadth of the preliminary scopes of the Application Protocols (APs) for the PAS-C Program. The PAS-C Program addresses two critical national technologies--composites and product data exchange tools. Each of these emerging technologies exist in a dynamic environment. Not only are there fast paced technical changes, but there are also frequent changes in the organizations involved in formulating the technology. PAS-C has developed a set of approaches that will maximize the success of the PAS-C Program and minimize the risks associated with the changes that are on going in both the technology and the environment. GRA

N93-19998# South Carolina Research Authority. Charleston.
PDES APPLICATION PROTOCOL SUITE FOR COMPOSITES (PAS-C) 1992 ANNUAL REPORT FOR THE PAS-C PROGRAM Final Report, 1 Sep. 1991 - 31 Aug. 1992
Glen Ziolko, Sonja Baluch, Larry Karns, Jody Anderson, and Floyd Ganus 30 Sep. 1992 28 p
(Contract F33615-91-C-5713)
(AD-A258625; WL-TR-92-8069) Avail: CASI HC A03/MF A01

This annual report conveys the accomplishments of the PDES Application Protocol Suite for Composites (PAS-C) Program for the period September 1, 1991 through August 31, 1992. This time period primarily covers Phase 1, the Needs Analysis, and the kickoff of Phase 2, Application Protocol Development. The report also describes how these accomplishments will be used in the upcoming program phases. GRA

N93-20000# Air Force Inst. of Tech., Wright-Patterson AFB, OH. Foreign Aerospace Science and Technology Center.
S. G. ROMANOVSKIY METHOD OF THERMAL TREATMENT AND DRYING OF NONCONDUCTING MATERIALS (DESCRIPTION OF AN INVENTION FOR AN AUTHOR'S CERTIFICATE)
S. G. Romanovskiy 6 Nov. 1992 6 p Transl. into ENGLISH from Russian Patent Nr. 339734 (USSR) 24 May 1992 by Charles T. Ostertag, Jr p 1-2
(AD-A258631; FASTC-ID(RS)T-0488-92) Avail: CASI HC A02/MF A01

Methods are known for heat treatment and drying of nonconducting materials, wood for example, in an electromagnetic field which is created by currents of industrial frequency. The purpose of the invention is intensification of the process, improvement of quality, and cutting down of energy expenditures. This goal is achieved by means of heating the mateial up to a temperature of 60-140 C and its isothermal holding at this temperature, and then it is cooled, to 30-60 C for example, for equalizing the temperature throughout the thickness of the material, after which the operations of heating, isothermal holding and cooling are repeated up until a material with the assigned final moisture content is obtained. Here the supply of heat to the material may be either discrete-conductive or radiation-conductive, for example, from ferromagnetic elements which do not come in contact with the material being treated. GRA

N93-20015 Department of the Navy, Washington, DC.
SEGMENTED COMPOSITE CYLINDER ASSEMBLY Patent
Paul Coffin, inventor (to Navy) 27 Oct. 1992 17 p Filed 21 Feb. 1992
(AD-D015603; US-Patent-5,158,203; US-Patent-Appl-SN-838985) Avail: US Patent and Trademark Office

A circumferential rib-stiffened hollow cylinder and method for fabrication thereof featuring construction of the cylinder from complementarily shaped nestled prefabricated rings and resultant circumferential ribs which are integral with the rest of the cylinder. In one embodiment ring sections which are L -shaped in cross-section are axially and sequentially mated; ring sections which are U -shaped are axially and correspondingly integrated therewith. therein for a cylinder having internal circumferential ribs and thereout for a cylinder having external circumferential ribs. The dominant load path for the cylinder is through the reinforced cylinder elements, and the cylinder's wall-thickness-to-diameter ratio is effectively reduced, thereby allowing radial reinforcement of the ribs, reducing residual stresses and increasing strength; these advantages are especially significant for cylinders which are composite or are to be subjected to hydrostatic pressure. Moreover, in comparison with conventional cylinders of monocoque construction, manufacture and quality control may be expected to be more economical and cost-effective. GRA

N93-20016 Department of the Navy, Washington, DC.
MASS LOADED COMPOSITE ROTOR FOR VIBRO-ACOUSTIC APPLICATION Patent
William K. Blake, inventor (to Navy), Aleksander B. Macander, inventor (to Navy), and Jonathan Gershfeld, inventor (to Navy) 8 Sep. 1992 8 p Filed 28 Aug. 1990
(AD-D015604; US-Patent-Appl-SN-573769) Avail: CASI HC A02/MF A01

This patent discloses a rotor and a method for the production thereof which incorporates the inherently strong, highly damped, yet light weight characteristics of fiber reinforced plastic composites, achieving with a minimal amount of added weight in the form of high density material a significant reduction in the vibratory response of the rotor due to hydrodynamic flow excitation, by selectively tailoring the mass distribution therein as by adding the high density material at selected locations of the rotor. GRA

N93-20040*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
FIBER-REINFORCED MONOCLINIC CELSIAN MATRIX COMPOSITE MATERIAL Patent Application
N. P. Bansal, inventor (to NASA) and J. A. DiCarlo, inventor (to NASA) 7 Dec. 1992 5 p
(NASA-Case-LEW-15269-1; NAS 1.71:LEW-15269-1;
US-Patent-Appl-SN-986399) Avail: CASI HC A01/MF A01

A hyridopolysilazane-derived ceramic fiber reinforced monoclinic celsian phase barium aluminum silicate glass-ceramic matrix composite material is prepared by ball-milling an aqueous slurry of BAS glass powder and fine monoclinic celsian seeds. The fibers improve the mechanical strength and fracture toughness. These fibers further provide superior dielectric properties. NASA

N93-20123# Army Armament Research, Development and Engineering Center, Watervliet, NY. Benet Lab.
NONDESTRUCTIVE EVALUATION OF COMPOSITES USING INFRARED IMAGING Final Report
Mark E. Todaro and Mark A. Doxbeck Nov. 1992 18 p
(AD-A259412; ARCCB-TR-92047) Avail: CASI HC A03/MF A01

Benet Laboratories is pursuing methods for nondestructively evaluating composite materials and structures associated with large caliber gun tubes, including items already being manufactured, such as the bore evacuator, as well as experimental items, such as the thermal shroud and composite-reinforced gun tubes. Typical needs include identifying delaminations between the composite and a substrate, delaminations between composite layers, damage from later manufacturing processes, and impact damage during use. Recent in-house work included obtaining images of delaminations in fiber-reinforced, layered composite plates using an infrared video system. The surface of the composite was briefly heated by quick pass with a hot air gun, while an infrared video camera recorded the changing pattern of infrared radiation emitted from the heated surface. From the intensity of this radiation, the system calculated the temperature at each scanned element of the surface for subsequent display, storage, and processing. The surface cools primarily by diffusion of heat into the

bulk of the material; and discontinuities, therefore, tend to block the flow of heat and inhibit cooling. In these experiments, the surface of the composite above a delamination did not cool as quickly after heating as the surrounding regions. In the frames recorded immediately after the pass of the hot air gun, the surfaced above delaminations were clearly visible as hot spots. A one-dimensional finite difference algorithm was used to model transient surface temperatures due to an energy pulse incident on a layered material, such as a composite, with or without delaminations. GRA

N93-20124# Pennsylvania State Univ., University Park.
MICROSTRUCTURAL DEVELOPMENT IN A SPRAY FORMED ALUMINUM-SILICON CARBIDE BASED METAL MATRIX COMPOSITE Annual Report No. 2, 1 Jan. - 31 Dec. 1992
Paul R. Howell 1992 38 p
(Contract N00014-91-J-1648)
(AD-A259414) Avail: CASI HC A03/MF A01

The aging response of an 8090-SiC composite at 190 C has been monitored using microhardness tests, macrohardness tests, and transmission electron microscopy (TEM). Intriguingly, it was found that the composite does not exhibit increased aging kinetics when compared with a control 8090 alloy. Both the control alloy and the composite exhibit a two stage strengthening behavior which is attributed to the precipitation of delta'(Al3Li) and S'(Al2CuMg). Quantitative microscopy of the composite was initiated since it was found that T2(Al6CuLi3), precipitates on the SiC/matrix interface. Hence, the interfacial area per unit volume(Sv) is of the utmost importance. Finally, the effects of T2 precipitates, at the SiC/matrix interface, on the distribution of delta' were determined. GRA

N93-20317*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EFFECTS OF THERMAL AND MECHANICAL FATIGUE ON THE FLEXURAL STRENGTH OF G40-600/PMR-15 CROSS-PLY LAMINATES
Gary D. Roberts, Barry Ping Hsiao Ho (Case Western Reserve Univ., Cleveland, OH.), and John F. Wallace (Case Western Reserve Univ., Cleveland, OH.) Feb. 1993 24 p
(RTOP 505-63-5A)
(NASA-TM-106016; E-7573; NAS 1.15:106016) Avail: CASI HC A03/MF A01

The effects of thermal and mechanical fatigue on the flexural strength of G40-600/PMR-15 cross-ply laminates with ply orientation of (0(2),90(2))2S and (90(2),0(2))2S are examined. The relative importance of shear and tensile stresses is examined by varying the span-to-depth ratios of flexural test specimens from 8 to 45. Acoustic emission signals are measured during the flexural tests in order to monitor the initiation and growth of damage. Optical microscopy is used to examine specimens for resin cracking, delamination, and fiber breaks after testing. Transverse matrix cracks and delaminations occur in all specimens, regardless of ply orientation, span-to-depth ratio, or previous exposure of specimens to thermal and mechanical fatigue. A small amount of fiber tensile fracture occurs in the outer 0 deg ply of specimens with high span-to-depth ratios. Because of the complex failure modes, the flexural test results represent the 'apparent' strengths rather than the true flexural or shear strengths for these cross-ply laminates. Thermal cycling of specimens prior to flexural testing does not reduce the apparent flexural strength or change the mode of failure. However, fewer acoustic events are recorded at all strains during flexural testing of specimens exposed to prior thermal cycling. High temperature thermal cycling (32 to 260 C, 100 cycles) causes a greater reduction in acoustic events than low temperature thermal cycling (-85 to +85 C, 500 cycles). Mechanical cycling (0 to 50 percent of the flexural strength, 100 cycles) has a similar effect, except that acoustic events are reduced only at strains less than the maximum strain applied during flexural fatigue. Author

N93-20550# Wright Lab., Wright-Patterson AFB, OH.
COMPRESSION-AFTER-IMPACT BEHAVIOR OF ARALL(TRADE NAME)-1 LAMINATES Final Report, Jun. - Nov. 1987
William P. Hoogsteden 14 Jul. 1992 52 p
(AD-A259203; WL-TR-91-4090) Avail: CASI HC A04/MF A01

ARALL (trademark) laminates are the first generation of a new class of materials combining the best properties of metals and composite materials. This report represents part of a Phase 1 of a two phase study of ARALL(R)-1 laminates. Ten specimens were tested in a modified Boeing Compression-After-Impact fixture. Two specimens were undamaged. The remaining eight received impacts of 2.3 ft-lbs (3.18 J), 5.5 ft-lbs (7.5 J), 10.4 ft-lbs (14.1 J), and 11.7 ft-lbs (15.9 J). Only dents were produced at 2.3 ft-lbs (3.18 J). Back face cracks appeared at 5.5 ft-lbs (7.5 J). Full penetration was achieved at 10.4 ft-lbs (14.1 J). Interior damage as measured by ultrasonic 'C' scan showed little damage beyond that already visible on the surface. Compressive buckling was the mode of failure. Increasing impact energy decreased the buckling load of the specimens. 'C' scans taken after compression testing revealed no growth of the interior damage. GRA

N93-20568*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
HEAT TRANSFER DEVICE Patent Application
Bruce A. Banks, inventor (to NASA) and J. R. Gaier, inventor (to NASA) 10 Feb. 1993 11 p
(NASA-Case-LEW-14162-4; NAS 1.71:LEW-14162-4;
US-Patent-Appl-SN-017402) Avail: CASI HC A03/MF A01

Gas derived graphite fibers generated by the decomposition of an organic gas are joined with a suitable binder. This produces a high thermal conductivity composite material which passively conducts heat from a source, such as a semiconductor, to a heat sink. The fibers may be intercalated. The intercalate can be halogen or halide salt, alkaline metal, or any other species which contributes to the electrical conductivity improvement of the graphite fiber. The fibers are bundled and joined with a suitable binder to form a high thermal conductivity composite material device. The heat transfer device may also be made of intercalated highly oriented pyrolytic graphite and machined, rather than made of fibers. NASA

N93-20606# Pennsylvania Univ., Philadelphia.
THE OVERALL RESPONSE OF COMPOSITE MATERIALS UNDERGOING LARGE DEFORMATIONS Final Report, 1 Feb. 1991 - 31 Aug. 1992
Pedro Ponte Castaneda 15 Oct. 1992 262 p
(Grant AF-AFOSR-0161-91)
(AD-A259278; AFOSR-93-0002TR) Avail: CASI HC A12/MF A03

This research deals with the theoretical prediction of the effective behavior of nonlinear composite materials undergoing large deformations. In particular, applications are envisaged to the high temperature creeping behavior of metal/metal, metal/ceramic composites, and also of porous materials. Both isotropic and anisotropic configurations are considered, including the technologically important case of fiber-reinforced composites and the fundamentally important case of polycrystalline aggregates. The approach is based on new variational principles developed recently by the author (under AFOSR sponsorship), which allow the estimation of the overall behavior of a given nonlinear composite in terms of the effective properties of a suitably optimized linear comparison composite (with the same microstructure). The key advantage of the method is that it allows direct application of the extensive literature on linear composite materials, in the form of estimates and rigorous bounds, to obtain corresponding results for nonlinear composites. Additionally, the procedure is remarkably simple to implement, and the final results are usually expressed in terms of finite-optimization problems, which can be readily solved with modest computational effort. Recent progress includes the application of the method to the determination of extremal yield surfaces for anisotropic rigid/plastic systems and to the computation of estimates for the effective yield stress of polycrystalline aggregates. GRA

N93-20780 Department of the Navy, Washington, DC.
METHOD OF MAKING COMPOSITE FIELD-EMITTING ARRAYS Patent
Jack D. Ayers, inventor (to Navy) 8 Sep. 1992 7 p Filed 1 Nov. 1990 Supersedes N91-24514 (29 - 16, p 2621), AD-D014850
(AD-D015541; US-Patent-5,145,435; US-Patent-Appl-SN-607955;
US-Patent-Class-445-24) Avail: US Patent and Trademark Office

A field-emitting array is provided which comprises at least one thin wafer having electrically conducting filaments extending through a glass matrix between a first and second parallel surface of the wafer. At the first surface, the filaments extend beyond the plane of the glass matrix. The filaments extending beyond the first surface have an electron-emitting coating on their cylindrical surfaces. The coating extends beyond the filament end to create a shape that emits electrons when an electrical field is applied between the filaments and an anode. In an alternative embodiment, the filaments are recessed below the first surface and a conducting coating forms an extractor on that surface. GRA

N93-20801 Department of the Navy, Washington, DC.
METHOD OF BONDING METAL CARBIDES IN NON-MAGNETIC ALLOY MATRIX Patent
David Goldstein, inventor (to Navy) and Scott M. Hoover, inventor (to Navy) 8 Sep. 1992 6 p Filed 5 Jul. 1984
(AD-D015591; US-Patent-5,145,506; US-Patent-Appl-SN-627937) Avail: US Patent and Trademark Office

A non-magnetic, wear resistant composite of from 10 to 45 volume percent of titanium carbide or tungsten carbide particles bonded in a matrix of a nickel-titanium alloy wherein nickel comprises from 53 to 62 weight percent of the alloy with the remainder being essentially titanium is presented. GRA

N93-20845# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Helicopter Div.
DEVELOPMENT OF CURE CYCLES: FROM LABORATORY ANALYSIS AND TESTING TO PRODUCTION OF LARGE SCALE COMPOSITES
Peter Auer, Rainer Neumaier, and Klaus Schmidtke 1992 16 p Presented at 13th International Conference and Exhibition on Advanced Materials and Structures, from Research to Application, Hamburg, Germany, 11-13 May 1992
(MBB-Z-0442-92-PUB; ETN-92-92757) Avail: CASI HC A03/MF A01

The development of the different cure cycles is described concentrating upon the transformation from laboratory data to production scale. The latter is summarized in tables which compare laboratory conditions to differences and problems arising from the dimensions of large complex parts. The differences between laboratory and production scale and the resulting difficulties are discussed for three structural parts: a helicopter rotor system, a railway bogie, and aircraft fuselage. The manufacturing routes of the components for the helicopter rotor systems and the railway bogie is the same. They are based on thermal analysis investigations, (directional scanning calorimetry), and these are described. For the production of large complex parts for aircraft, the cure cycle has to be modified according to material related difficulties, problems associated with the curing reaction, and manufacturing facilities. Each of these are considered and discussed. ESA

N93-20869# Aerospatiale, Paris (France).
CONTRIBUTION TO THE STUDY OF COMPOSITE MATERIAL BEHAVIOR IN SPACE ENVIRONMENT [CONTRIBUTION A L'ETUDE DU COMPORTEMENT DES MATERIAUX COMPOSITES EN AMBIANCE SPATIALE]
P. Plotard (Aerospatiale Aquitaine, Saint-Medard en Jalles, France.) 1992 12 p In FRENCH
(Rept-921-430-112; ETN-93-91940) Avail: CASI HC A03/MF A01

Equipment to measure the stability and 'in-situ' physicomechanical behavior of structural composite materials in a simulated space environment is presented. Results obtained with carbon fiber and Kevlar fiber composites with epoxy and PEEK matrices are presented. ESA

N93-20919*# Virginia Polytechnic Inst., Blacksburg. Dept. of Engineering Science and Mechanics.
NONLINEAR PROBABILISTIC FINITE ELEMENT MODELS OF LAMINATED COMPOSITE SHELLS Final Report
S. P. Engelstad and J. N. Reddy Feb. 1993 203 p
(Grant NAG3-933; RTOP 510-01-50)
(NASA-CR-191069; E-7579; NAS 1.26:191069) Avail: CASI HC A10/MF A03

A probabilistic finite element analysis procedure for laminated composite shells has been developed. A total Lagrangian finite element formulation, employing a degenerated 3-D laminated composite shell with the full Green-Lagrange strains and first-order shear deformable kinematics, forms the modeling foundation. The first-order second-moment technique for probabilistic finite element analysis of random fields is employed and results are presented in the form of mean and variance of the structural response. The effects of material nonlinearity are included through the use of a rate-independent anisotropic plasticity formulation with the macroscopic point of view. Both ply-level and micromechanics-level random variables can be selected, the latter by means of the Aboudi micromechanics model. A number of sample problems are solved to verify the accuracy of the procedures developed and to quantify the variability of certain material type/structure combinations. Experimental data is compared in many cases, and the Monte Carlo simulation method is used to check the probabilistic results. In general, the procedure is quite effective in modeling the mean and variance response of the linear and nonlinear behavior of laminated composite shells. Author

N93-20931# Aerospatiale, Paris (France). Div. Systemes Strategiques et Spatiaux.
TRACTION AND SHEARING DYNAMICS OF A THREE DIMENSIONAL CARBON/CARBON COMPOSITE [TRACTION ET CISAILLEMENT DYNAMIQUES D'UN COMPOSITE CARBONE/CARBONE TRIORTHOGONAL]
J. M. Lequertier (Aerospatiale Aquitaine, Saint-Medard en Jalles, France.), H. K. Yang (Ecole Nationale Superieure de Mecanique, Nantes, France.), and C. Y. Chiem (Ecole Nationale Superieure de Mecanique, Nantes, France.) 1992 8 p In FRENCH
(Rept-921-430-109; ETN-93-91937) Avail: CASI HC A02/MF A01

A triorthogonal carbon/carbon composite (3D-PITCH) was tested in dynamic tensile and shear loading using split Hopkinson bar technique for strain rates between 100 and 1000/s. Results show high sensitivity of ultimate stress comparison to the apparent yield stress in dynamic tensile and shear loading tests. Microstructural observation shows the different features of fracture surfaces according to various strain rates and types of loading. ESA

N93-20937# Aerospatiale, Paris (France).
AN EXPERT SYSTEM TO STUDY BONDED JOINTS [UN SYSTEME EXPERT POUR L'ETUDE DES LIAISONS COLLEES]
J. P. Maigret 1992 7 p In FRENCH
(Rept-921-430-113; ETN-93-91941) Avail: CASI HC A02/MF A01

The development and applications of the expert system ACLICO which is used in the design of bonded joints are presented. This expert system is used to study problems, choose adhesives, oversee structural harmonization, study polymerization, and to perform detailed studies of joints and global thermomechanical analyses. ESA

N93-20939# Aerospatiale, Paris (France).
MEASUREMENT OF THE EXPANSION COEFFICIENT BETWEEN -150 C AND +150 C FOR MATERIAL COMPOSITES FOR SPACE APPLICATIONS [MESURE DU COEFFICIENT DE DILATATION ENTRE -150 C ET +150 C POUR DES MATERIAUX COMPOSITES A VOCATION SPATIALE]
C. LeFloch (Aerospatiale Aquitaine, Saint-Medard en Jalles, France.), F. Perrot (Aerospatiale Aquitaine, Saint-Medard en Jalles, France.), and M. Migayron (Aerospatiale Aquitaine, Saint-Medard en Jalles, France.) 1992 8 p In FRENCH
(Rept-921-430-115; ETN-93-91943) Avail: CASI HC A02/MF A01

Due to their low density, composite materials are interesting for use in satellites and orbital space stations. The dimensional stability of these materials must be guaranteed between -150 and +150 C corresponding to the temperature depending or whether or not the structure is facing the Sun. A method of testing the expansion coefficient of material composites supposedly stable at these temperatures was developed. The method is based on the Michelson interferometer, one of the arms of which elongates due to the expansion of the test specimen. The test is carried out under a secondary vacuum, has a sensitivity of 0.8 microns and is completely automatic. The measurement procedure is outlined and examples of results given. ESA

N93-20942# Institut National des Sciences Appliquees de Lyon, Villeurbanne (France). Groupes d'Etudes de Metallurgie Physique et de Physique des Materiaux.
EXPERIMENTAL AND THEORETICAL STUDY OF THE ELASTIC AND MICROPLASTIC PROPERTIES OF PARTICLES REINFORCED METAL MATRIX COMPOSITES Ph.D. Thesis [ETUDE EXPERIMENTALE ET THEORIQUE RES PROPRIETES ELASTIQUES ET MICROPLASTIQUES DES COMPOSITES A MATRICE METALLIQUE A RENFORT SOUS FORME DE PARTICULES]
Ronald Hamann 1992 609 p In FRENCH
(ISAL-92-0014; ETN-93-92696) Avail: CASI HC A99/MF A05

A critical review of mechanical behavior models is given. Most of them use the following hypothesis: the mean strain field of the matrix controls the behavior of the composite. The elastic limit of the composite matrix is

evaluated. The results of experiments performed in an aluminum matrix composite reinforced with silicon carbide particles are reported. The elastic limit under compression is inferior to that under traction, while by using conventional tests the results are exactly the opposite. To explain those results, the local strain field must be taken into account. An approach, based on the dislocation motions and applied to quenching processes is proposed. An interactive based on Eshilby analysis is developed and the models for calculating thermal-elastic constants are reviewed. ESA

N93-21055# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Hubschrauber und Flugzeuge.

INFLUENCE OF REINFORCING FIBERS ON THE CAPACITY FOR RESISTANCE TO IMPACT LOAD, OF COMPOSITE MATERIALS [EINFLUSS DER VERSTAERKUNGSFASERN AUF DIE WIDERSTANDSFAEHIGKEIT VON VERBUNDERWERKSTOFFEN GEGEN SCHLAGBEANSPRUCHUNG]

G. Herrmann (Badische Anilin- und Soda-Fabrik A.G., Ludwigshafen am Rhein, Germany.), J. W. Vilsmeier (Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn, Germany.), and J. Fischer (Badische Anilin- und Soda-Fabrik A.G., Ludwigshafen am Rhein, Germany.) Jun. 1991 19 p In GERMAN Presented at DGLR-Symposium Leichtbaustrukturen unter kurzzeitiger Beanspruchung (Impact, Crash), Bremen, Germany, 6-7 Jun. 1991 Submitted for publication

(MBB-FE-202-S-PUB-0496; ETN-93-93426) Avail: CASI HC A03/MF A01

Parallel investigations were carried out in two independent laboratories in order to achieve a better understanding of the corresponding influence of reinforcing fibers in composite materials. Various determining values were compared for five fibers with Intermediate Modulus (IM) and for two standard fiber reinforced composite materials, with each time equal matrix resin. Values were obtained for residual strength, crack toughness, and edge delamination strength, besides standard mechanical values. The discussion of results showed that good damage tolerance is required. ESA

N93-21129# Technical Research Centre of Finland, Espoo. Textile Lab.

TEXTILES AND COMPOSITES 1992

Harriet Meinander, ed. 1992 344 p Symposium held in Tampere, Finland, 15-18 Jun. 1992

(VTT-Symposium-133; ISBN-951-38-4084-0; ETN-93-93541) Copyright Avail: CASI HC A15/MF A03

The main themes of the symposium were: special fibers, composite materials, and functional clothing. Papers covering reviews of markets and research in the field as well as a large spectrum of basic and applied research results from different companies and institutions are presented. In addition, business logistics and electronic data exchange as well as standardization in the textile and clothing field were covered. For individual titles, see N93-21130 through N93-21166.

N93-21130# Yamagata Univ. (Japan). Dept. of Materials Science and Engineering.

FIBER DEVELOPMENT IN JAPAN

Koichiro Yonetake *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 52-57 (For primary document see N93-21129 07-24)

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Statistics relating to fiber development in Japan are given and discussions on the development of spinning methods, high performance fibers, and high functional fibers are presented. Research and development projects, including high performance polymers and composite materials, are listed: materials, biotechnology, electron devices, superconductivity, and software. High speed spinning of polyester fiber and the preparation of high strength high modulus polyethylene fibers using a gel spinning method are reported. High performance fibers discussed include the aromatic polyamide composed of p-phenylenediamine and 3,4-diaminodiphenylether, the aromatic copolyster fiber 'Vectran', PBZT (poly p-phenylene benzobisthiazole) fiber, and the nylon 46 fiber. Ultrafine denier fibers made by different manufacturing methods, and biomedical fibers, including the polyglycol acid 'Medfit' suture thread and hollow fibers for blood purification are discussed. ESA

N93-21131# Institut fuer Verbundwerkstoffe G.m.b.H., Kaiserslautern (Germany).

THERMOPLASTIC COMPOSITES FOR STRUCTURAL APPLICATIONS: PAST AND FUTURE

M. Neitzel *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 73-81 (For primary document see N93-21129 07-24)

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An overview of both the state of the art as well as the future prospects of thermoplastic composites is presented. The main material characteristics and processes of market available thermoplastic composites are compared to thermoset systems. The potential and drawbacks of thermoplastic composites are spotlighted and followed by a number of development opportunities and necessities to satisfy the scientific and economical questions left open. The need for semifinished suppliers to come up with materials that make a material substitution towards thermoplastic composites acceptable (for example in the automobile industry) is stated in conclusion. Flanked by these large volume targets, there remains the development of the aerospace and sports applications that technologically will stay ahead. ESA

N93-21132# Neste Oy, Porvoo (Finland).

FABRICATION OF UNIAXIALLY ORIENTED COMPOSITES FROM AS-SPUN AND HEAT-TREATED THERMOTROPIC LIQUID CRYSTALLINE POLYMER FIBERS

Esa Suokas *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 82-86 (For primary document see N93-21129 07-24)

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A study which shows that it is possible to achieve better mechanical properties of Liquid Crystalline Polymers (LCP's) by composite fabrication than by injection molding is presented. Injection molding of thermotropic LCP's normally results in typical layer structure of a longitudinal skin and a transversely oriented core. Usually, the former is thought to originate in elongational flow and the latter in plug flow. There are sometimes additional layers between skin and core, the total number of different strata may be 7 or 9. The heterogeneous orientation of this microstructure, especially the core region, decreases the mechanical properties of LCP's. It is possible to replace the transversely oriented core area of the injection molded LCP by uniaxial fibers. The as-spun LC fibers serve as matrix and the heat treated ones as reinforcement in the composite specimens. The mechanical properties of the liquid crystalline polymer used increased due to the integrated filament winding and compression molding method. ESA

N93-21133# Universite Catholique de Louvain (Belgium). Unite de Physico-Chimie et de Physique des Materiaux.

THE EFFECT OF FIBER CONCENTRATION, LENGTH AND ORIENTATION ON THE THERMAL CONDUCTIVITY OF A POLYCARBONATE/PITCH-BASED CARBON FIBER COMPOSITE

A. Demain and J.-P. Issi *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 87-95 (For primary document see N93-21129 07-24)

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Thermal conductivity of different chopped carbon fibers/polycarbonate composites is studied as a function of concentration, orientation, and length of the fibers. It is shown that, even with chopped fibers, at room temperature, thermal conductivity comparable to that of stainless steel can be attained. Due to the large aspect ratio of the fibers, none of the models published in the literature can be used to fit the results. However, relations between concentration and aspect ratio that allow prediction of thermal conductivity are proposed. It is suggested that any further increase of the fibers aspect ratio to a value higher than 50 should not significantly improve the conductivity of the composite. The geometrical effect due to the existence of a maximum for the packing of fibers is shown to result in the occurrence of a maximum in the longitudinal thermal conductivities. ESA

N93-21134# Tampere Univ. of Technology (Finland). Inst. of Plastics Technology.

MANUFACTURING OF HIGH QUALITY POLYPROPYLENE/GLASS FIBRE PREPREG TAPE

Petri Peltonen, Kimmo Laehteenkorva, Esko Paakkonen, Pertti Tormala, and Pentti Jarvela *In* Technical Research Centre of Finland, Textiles

and Composites 1992 1992 p 96-103 (For primary document see N93-21129 07-24)
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The development of a technique for producing continuous fiber reinforced thermoplastic prepregs is reported. The technique is based upon melt impregnation. Several melt impregnation parameters were studied and the prepreg could be tailored to the user's preference. Results are detailed for the polymer temperature, impregnation time, the internal pressure in the die, the length of the contact surface between the pins and the roving, the MFR value of the polypropylene, and addition of the coupling agents.
ESA

N93-21135# Tampere Univ. of Technology (Finland). Inst. of Plastics Technology.
THERMOPLASTIC TAPE WINDING PARAMETERS
Kimmo Lahteenkorva, Petri Peltonen, Esko Paakkonen, Pentti Jarvela, and Pertti Tormala *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 104-110 (For primary document see N93-21129 07-24)
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The process parameters on thermoplastic tape winding are addressed. Analysis of processing parameters included: mandrel temperature, prepreg tension, roller compression on in situ consolidation, prepreg and wound surface warming, and winding speed. The effect of processing parameters on the wound part was evaluated by several different mechanical tests. Axial strength was the best indicator of wound part quality. Mandrel temperature and consolidation pressure effected mechanical properties most. The suitability of the Taguchi method for this kind of application was studied. Results suggest the method is useful in limited circumstances for thermoplastic composite winding.
ESA

N93-21136# Institut fuer Kunstsoffverarbeitung, Aachen (Germany).
PRODUCTION OF HIGHLY INTEGRATED FRP PARTS IN THE BRAIDING TECHNOLOGY
W. Michaeli and U. Rosenbaum *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 111-116 (For primary document see N93-21129 07-24)
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The braiding process for producing high quality Fiber Reinforced Parts (FRP) is described, and advantages over the conventional filament winding process are discussed. The braiding process is concluded to be an efficient method for making complex shaped parts with a closed surface, because the braid provides a self supporting weavelike fiber structure that allows for deviation from the geodesic path higher than in the filament winding process. The control program developed enables the user to ensure the desired fiber orientation. Thus, it appears to be possible, in connection with the resin transfer molding process, to produce high quality parts with a complex shape, that cannot be made in the filament winding process.
ESA

N93-21137# Parabeam Industrie- en Handelsonderneming B.V., Helmond (Netherlands).
WHAT'S A PARABEAM 3D?
Guus vanDijk *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 117-122 (For primary document see N93-21129 07-24)
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The Parabeam (company name) three dimensional (3D) fabric is described. The fabric is produced on velvet looms developed to enable weaving with technical fibers such as E glass. The 3D fabrics consist of two plain woven fabrics, woven simultaneously and at the same time bonded by the vertical fibers. Parabeam 3D fabrics can be used as reinforcement for polyester, vinylester, and epoxy matrices. Their polyester properties are described. They can be applied in a resin spray-up, hand lay-up, and preimpregnation process. Tests on laminate properties are described. Parabeam 3D fabric enables manufacturers to improve their products on several points, such as high bending stiffness and strength at a low weight, as a result of the integrated sandwich structure. They have a good formability compared with other core materials like foams. The hollow structure enables it to be used as a leak detection, cooling, or heating circuit.
ESA

N93-21138# Technical Research Centre of Finland, Espoo. Textile Lab.
CONTINUOUS FIBER REINFORCED THERMOPLASTIC COMPOSITES
Juha Sarlin and Marja-Terttu Tuomisto *In its* Textiles and Composites 1992 1992 p 123-124 (For primary document see N93-21129 07-24)
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A discussion of thermoplastic composites, as relative newcomers in the family of structural materials, is presented. Thermoset composites represent the major part of the total market for polymer matrix composites, but recent developments in the properties of polymers and in the processing technology have created circumstances where the industrial use of advanced thermoplastic composites, such as continuous fiber reinforced systems, has favorable economical and technical preconditions. Although the technical prospects of the industrial use of continuous fiber reinforced thermoplastic composites seem promising, an important viewpoint in using these materials is the production economics. Most of today's applications serve the aeroplane industry, where processing costs are not as critical in relation to properties of products as in many other sectors. Thus, a wider development of the continuous fiber reinforced thermoplastic composites would require new applications, especially in areas where production costs are more critical.
ESA

N93-21139# Tampere Univ. of Technology (Finland). Inst. of Plastics Technology.
WETTING OF FIBERS MEASURED BY LPR-90 EQUIPMENT
Alli Jaala, Pentti Jarvela, and J. LeBell (Partek Oy A.B., Parainen, Finland.) *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 125-131 (For primary document see N93-21129 07-24)
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Measurements with the LPR-90 (Liquid Penetration) method, which is based on Washburn equation describing the wetting properties of powders as an initial rate of wetting, are described. LPR-90 equipment is developed where the adsorption of liquids to the surface of fibers and powders or desorption is important. It may be used, for example, for comparing effects of different surface treatments and optimizing the amount of surface active agents and treatment circumstances. The method is simple and rapid. The initial rate of wetting was measured for mineral wool fibers with distilled water and different concentrations of ethanol solutions. The results show that the initial rate of wetting of hydrophobic fibers decreases and of hydrophilic fibers rises as the concentration of ethanol in water solution rises. The effect of different surface treatments was studied with mica containing 0.5 wt percent different silanes. The results show that the wetting properties depend upon the used silane. The effect of the amount of surface active agents in fillers surface was studied with mica as a function of silane concentration. When the concentration of silane rises, the initial rate of wetting with distilled water and 1-propanol also increases.
ESA

N93-21140# Technical Research Centre of Finland, Espoo. Machine Automation Lab.
DYNAMIC MECHANICAL PROPERTIES OF PLASTIC COMPOSITES MEASURED BY DMTA TECHNIQUE
Pirkko Jarvela, Timo Rantanen, and Hannu Minkkinen *In its* Textiles and Composites 1992 1992 p 132-137 (For primary document see N93-21129 07-24)
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The effects of weathering on the dynamic mechanical properties of different types of glass fiber/resin systems were determined at a large temperature range at load frequencies 1 and 10 Hz. In weathering, ultraviolet radiation and moisture condensation were used alternatively in four hours cycles. To study the effect of heat treatment, a glass fiber reinforced epoxy sample was run in Dynamic Mechanical Thermal Analyzer (DTMA) repeatedly without reclamping it. Mineral filled polypropylene was used to study the effect of filler in dynamic mechanical properties of thermoplastic. The most remarkable effect of weathering can be seen in tan delta values. The T(sub g) shifts to higher temperature and also its magnitude can change because of weathering. The annealed composites show higher T(sub g) relaxation temperature since the degree of cure is increased. Mineral filled polypropylene shows higher modulus values than nonfilled due to the increase of stiffness of a compound. Useful examples of the possible research areas of dynamical mechanical thermal analysis are shown.
ESA

N93-21141# Fachhochschule fuer Technik und Wirtschaft, Reutlingen (Germany).
MANUFACTURE AND APPLICATION OF BIAXIAL AND MULTIAXIAL KNITS AS TEXTILE REINFORCEMENTS IN COMPOSITE MATERIALS
Chandrasekhar Iyer *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 138-146 (For primary document see N93-21129 07-24)
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An introduction to warp knitting and a description of the construction of advanced directional structures containing axially oriented yarn layers and a comparison with woven fabrics are presented. Main emphasis is laid on the buildup of multiaxial knits with detailed reference to the LIBA (warp knitting with multiaxial weft insertion system) technique. Advantages in using such structures as composites are illustrated by indicating various fields of application. A video film will show fabric production on the LIBA Copcentra Multiaxial Machine. ESA

N93-21142# Technische Hochschule, Aachen (Germany). Dept. of Textile Technology.
NEW TYPES OF TEXTILE FABRICS FOR FIBRE COMPOSITES
Karlheinz Hoersting and Wulfhorst Burkhard *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 147-156 (For primary document see N93-21129 07-24)
Copyright Avail: CASI HC A02/MF A03

Two processes from the field of knitting technology which fulfill requirements for rationalizing the finishing process are presented: WIMAG (German acronym for the warp knitted multiaxial layer); and NVG (German acronym for the stitch bonded variable layer). In addition, the mechanical properties of a fiber composite component can be improved by stress resistant orientated reinforcing fibers. This project should investigate the suitability of both of these procedures for special fields of application. A presentation of the finishing principles is given. The qualification of the reinforcing textiles, WIMAG and NVG, is to be conducted by comparing the mechanical properties of the dry textile and the impregnated textile, as well as by using an example of a component. ESA

N93-21143# Institut fuer Kunstsoffverarbeitung, Aachen (Germany).
PREDESIGN OF THE TUBULAR BRAIDING PROCESS USING A MATHEMATICAL PROCESS DESCRIPTION
W. Michaeli and M. Jehrke *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 157-165 Sponsored by Arbeitsgemeinschaft Industrieller Forschungsvereinigungen e.V., and Forschungskuratorium Maschinenbau e.V. (For primary document see N93-21129 07-24)
Copyright Avail: CASI HC A02/MF A03

Long fiber reinforced and complex shaped parts can be effectively produced using tubular braiding technology. The predesign of the braiding prior to actual manufacturing is possible using a mathematical process description. During the predesign, the feasibility of the braiding process is checked, and the expected braid properties are determined. The control data for the braiding process are generated and transferred to machine control. In combination with the described proceses strategy, the tubular braiding technology offers an efficient method for the production of complex shaped fiber reinforced plastic parts with a closed surface. It provides some useful advantages compared with filament winding using a ring feed eye: high productivity since a high number of fibers are processed at the same time. The self supporting braid structure offers the possibility to produce more complex shaped parts. Longitudinal fiber reinforcement can easily be integrated into the laminate and the generation of control data for the machine control is much easier. ESA

N93-21144# Heriot-Watt Univ., Edinburgh (Scotland). Faculty of Textiles.
RELATIONSHIPS BETWEEN LAYER LINKAGE AND MECHANICAL PROPERTIES OF 3D WOVEN TEXTILE STRUCTURES
X. Chen, R. T. Knox, D. F. McKenna, and R. R. Mather *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 166-172 Sponsored by British Aerospace, and Coats Viyella Public Ltd. Co. (For primary document see N93-21129 07-24)
(Grant SERC-GR/G-16571)
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The relationship between methods of stitching in multiple layer fabrics and their mechanical properties is investigated. The layer linkage of 3D (three dimensional) woven structures is one of the key aspects affecting their mechanical behavior. Frequency of stitching is used as a measure of the degree of layer linkage. Tensile and shearing tests on two and three layer fabrics show a positive linear relationship between shearing modulus and the frequency of stitching and a negative linear relationship between Young's modulus and the frequency of stitching in only the stitching direction. Interlocking fabrics are found to have lower shearing and Young's moduli. The following conclusions are made: there seems to be a positive linear relationship between the shearing modulus and the frequency of stitching in stitched fabrics; Young's modulus appears to have negative linear relationships only in the stitching direction in stitched fabrics; other conditions being the same, interlocking fabrics seem to have a lower shearing modulus, and a lower Young's modulus. ESA

N93-21145# Technical Research Centre of Finland, Espoo. Textile Lab.
NEAR NET SHAPE KNITTING OF FIBER GLASS AND CARBON FOR COMPOSITES
Mikael Epstein and Salme Nurmi *In its* Textiles and Composites 1992 1992 p 173-178 (For primary document see N93-21129 07-24)
Copyright Avail: CASI HC A02/MF A03

Knitting technologies, materials, and experiments concerning reinforcement fabrics of glass, carbon, and other reinforcement fibers are described. Knitting could bring a number of advantages, one of which would be the ability to produce near net shaped reinforcement structures in the fabric production stage combined with stretchability of the fabric. Two basic knitting methods are available: weft knitting and warp knitting. Work so far has involved weft knitting of glass filament yarn and carbon filament yarn. Near net shape samples produced include the following: T pipe junction, cone, flanged pipe, and dome. Major problems encountered were fiber breakage, dusting and problems in the machinery caused by stiffness and low elasticity of the yarns. ESA

N93-21146# Universidad Politecnica de Catalunya (Spain). Dept. de Ciencia de Materiales.
EFFECT OF THE REINFORCEMENT FINISH IN THE MECHANICAL PERFORMANCES OF EPOXY-GLASS COMPOSITES
P. Pages, A. Andres, and J. Arnau *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 179-186 (For primary document see N93-21129 07-24)
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A study attempting to find the behavior of the silane type finish agents after their application on the reinforcement surface of epoxy glass composites is presented. The FT IR absorption bands, recorded by spectral substraction, clearly manifest the existence of a chemical bondage between glass surface and finish agents. The TRI microbond test suggests the polymerization of these agents when in contact with the matrix. This would explain the improvement of the composite interfacial performances and, thus, the increase of mechanical properties of these finish treated reinforcement composites. ESA

N93-21147# Lodz Univ. (Poland). Inst. of Chemical Fibers.
NEW SPECIAL CHEMICAL FIBRES
Alojzy Urbanowski *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 187-194 (For primary document see N93-21129 07-24)
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A number of new or modified polymers are described. Attention is given to different forms such as fibers and films, and discussions on related applications in medicine and textile technology are presented. Copoly(esterethers) (CPEE) were obtained in the reaction of polyetylene terephalate with polyetylene glycol. Film was cast and monofilaments were spun from CPEE using an extrusion spinning line equipped with a talc powdering device. Some properties of CPEE are given. Biodegradability tests of filaments made of polyamide-6 grafted with different quantities of acrylic acid are reported. A study on the possibility of obtaining a hydrophilic polyamide is described. Research on the application of carbon fibers and fabrics in medicine is reported, including the manufacture of absorbable plaited carbon sutures and absorbable carbon artificial ligaments. A process developed for silvering polyamide fibers to make them electrically conductive and suitable for antistatic applications is reported. The manufacture of

hollow fibers from polyacrynitrile, polysulphone, and other polymers, is discussed. ESA

N93-21148# Neste Chemicals N.V., Brussels (Belgium). Skill Centre Fibers.

FEATURES IN PO FIBRE APPLICATIONS

Ludo Vanschoren *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 195-198 (For primary document see N93-21129 07-24)

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A synopsis of the role of Polyolefins (PO's) in fiber applications is presented. The PO role is based on the combination of the advantages of PP in its traditional form as a homopolymer: versatility, competiveness, specific properties, wide range of tuned polymer grades, and recycling friendly potential. In general, PO's are considered not only as an alternative, but also as a complementary material for specific end uses. This comes about as a consequence of environmental regulations. The example of the automative industry is discussed. The main applications of nonwoven, consumer, and technical textiles are discussed. The use of PO's as high strength fibers is considered. ESA

N93-21149# Heriot-Watt Univ., Edinburgh (Scotland). Dept. of Technology.

THE PRODUCTION OF FIBRES FROM POLYPROPYLENE AND LIQUID CRYSTAL POLYMER BLENDS

Yimin Qin, Donald L. Brydon, Robert R. Mather, and Roger H. Wardman *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 199-205 (For primary document see N93-21129 07-24)

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The process of producing fibers from blends of polypropylene and a Liquid Crystal Polymer (LCP), Vectra A900, is reported. At appropriate extrusion and drawing conditions, it is shown to be possible to produce in situ composite fibers with high strength and modulus. The following conclusions are given: for the prolypropylene and Vectra A900 system, LCP fibrils can be generated within a range of LCP concentrations, preferably between pp/LCP wt/wt ratios of 100/5 and 100/15; the as-spun fibers can be significantly reinforced by introducing a LCP component; the properties of the pp/LCP polyblend fibers are related to the drawing arrangement; and multistage drawing prevents the fracture of the LCP fibrils to a large extent, thereby producing improved fiber properties. ESA

N93-21150# Kynol-Europa G.m.b.H., Hamburg (Germany).

KYNOL (TM) NOVOLOID FIBERS: SURVIVABLE FIBERS FOR TOUGH TIMES

Hasso Schwaenke *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 206-211 (For primary document see N93-21129 07-24)

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The chemical structure of Kynol fibers, amorphous crosslinked phenolaldehyde fibers which embody many of the characteristics of penolic resins, is shown. Kynol contains only the three chemical elements of carbon, hydrogen, and oxygen and therefore, has no toxic offgassing in flame and is a non-notifiable waste after use. Typical properties of Kynol fibers are given. Applications of Kynol fibers and textile materials for safety materials and industrial uses are discussed: garments, aircraft flame and smoke barriers; heat insulation and resistance to extremely low temperatures; industrial sealings and packings; composites, including friction materials; and cables. Carbon fiber and carbon fiber activated products are discussed. ESA

N93-21151# Lodz Univ. (Poland). Inst. of Chemical Fibers.

SPECIAL FIBRES FROM NATURAL POLYMERS

Henryk Struszczyk *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 212-219 (For primary document see N93-21129 07-24)

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Special fibers made from natural polymers such as chitosan, alginate, cellulose, and bacterial cellulose, are presented. The modified fibers containing special additives are discussed. Their properties, behavior--including biodegradability, and potential area of application are described. Biodegradability, biocompatibility, and high sorption of chitosan, alginate, and bacterial cellulose fibers have predisposed these products mainly for medical applications. Superabsorbent and bioactive viscose fibers may be utilized in medicine. ESA

N93-21152# Tampere Univ. of Technology (Finland).

ACTIVATED CARBON FIBERS IN COMPOSITES, CHEMICALLY PROTECTIVE CLOTHING AND AIR PURIFICATION

P. Nousiainen, M. Nieminen (Technical Research Centre of Finland, Espoo.), S. Heidari (Kemira Oy, Valkeakoski, Finland.), and J. Laine (Helsinki Univ. of Technology, Espoo, Finland.) *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 221-232 (For primary document see N93-21129 07-24)

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A discussion on Activated Carbon Fiber (ACF) production is presented. Results of chemical protection and adsorption-desorption properties for various solvents are discussed. ACF fabrics and activating viscose fabrics in various forms show a homogeneous, microporous structure with oxygen rich, acidic chemical groups on the fiber surface. Woven and knitted Visac ACF fabrics as laminates with flame retarded cotton and cotton polyester fabrics possess an effective protection against mustard liquid and gas. Organic solvent impurities at a high rate of air flow, can be easily adsorbed in nonwoven ACF fabric and removed by heat desorption. The boiling point and the chemical nature of the solvent should be taken into consideration when planning adsorption desorption systems. The pressure drop of the ACF nonwoven fabric can be affected by the thickness and structure of the fabric and the filter. ESA

N93-21153# Akzo Faser A.G., Wuppertal (Germany).

TWARON IN COMPOSITES AND PROTECTIVE CLOTHING

Dieter Schuster *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 233-238 (For primary document see N93-21129 07-24)

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Twaron, a para-aramid fiber with high tenacity and temperature stability, is described. Its chemical structure is shown and composites with Twaron are described. It is used in high performance composites for structural and ballistic applications. In clothing, Twaron is applied to protect against heat, and mechanical impact, for example stabbing and projectiles. ESA

N93-21154# Kemira Oy, Valkeakoski (Finland).

APPLICATIONS OF VISIL FIBRES IN FUNCTIONAL TEXTILES

Pekka Vapaaoksa *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 239-246 (For primary document see N93-21129 07-24)

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A type of hybrid Viscose-Silicic acid fiber (Visil) and its applications in various functional textiles are described. The production process is characterized by the following steps: using the raw materials, cellulose, sodium hydroxide and silica, the liquid form of sodium silicoxanthate is obtained; regeneration in sulphuric acid leads to simultaneous polymerization of cellulose and polysilicic acid; and after regeneration the normal fiber process takes place, including drawing, cutting, and finishing. The properties of Visil are outlined. Visil can be used in the following applications: flame retardant textiles, ceramic textiles, filtration materials, catalyst carriers, and friction products. ESA

N93-21155# Du Pont de Nemours International S.A., Geneva (Switzerland).

ARAMIDS IN HIGH PERFORMANCE PROTECTIVE CLOTHING

A. I. Stocks *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 247-253 (For primary document see N93-21129 07-24)

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A Nomex (trademark) 'Delta A' (for antistatic) fiber blend that provides excellent static electricity dissipation characteristics and that can be used to significantly reduce the risk of explosions in atmospheres where flammable vapors could be encountered is described. Another blend, Nomex 'Delta T' (for thermal performance), is shown to give clearly enhanced protection for personnel that might be exposed to flash fires or other sources of intense heat. The enhanced performance of this product could be achieved thanks to second generation, producer colored, Kevlar (trademark) 'Hc' fibers.

Both products are now commercially avaliable, and it is hoped that they will contribute to safety in a large variety of industries. ESA

N93-21156# Hoechst A.G., Augsburg (Germany).
THE TOTAL QUALITY APPROACH IN THE DEVELOPMENT OF TECHNICAL TEXTILES
Peter Knobloch *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 254-260 (For primary document see N93-21129 07-24)
Copyright Avail: CASI HC A02/MF A03

Procedures to be observed to ensure quality in textile development are described. The aim is to secure a strong market position through quality, and not through low prices and fast delivery. Quality in every position and quality with every employee are of importance, rather than total quality management. The International Standards Organization (ISO) 9000 to 9004 standard series is quoted as a help. The use of internal documents to make development processes visible is reported. Developments, particularly those in the field of technical textiles, are highly customer oriented and largely targeted to special applications. Development work in this field must also adhere to cost requirements and respect feasibility factors. At the same time, the developer should retain the scope necessary for the activity. ESA

N93-21157# Bolton Inst. of Tech. (England). School of Textiles Studies.
DEVELOPMENTS IN HEAT AND FLAME RESISTANT TEXTILES FOR PROTECTIVE CLOTHING AND BARRIER FABRICS
A. Richard Horrocks, Joseph Rutherford, Subhash C. Anand, and Diane Sanderson *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 261-269 Sponsored by British Technology Group (For primary document see N93-21129 07-24)
Copyright Avail: CASI HC A02/MF A03

Textiles which are currently available for use in protective end uses, such as protective clothing and barrier purposes, are reviewed. Their suitability may be determined in terms of appropriate tests for assessing flame retardancy (vertical strip and oxygen index tests), thermal protection (thermal protective index and molten drip resistance), and heat output (calorimetry). Recent developments include high performance aramid/carbon blends for extreme heat protection and a novel engineered structure designed to resist heat exposures of 900 to 1100 C for up to 10 minutes. In particular, a structure is outlined, which, unlike the available organic fiber containing barrier fabrics, retains mechanical integrity after charring of the organic content has occurred (up to 500 C) and, even after char oxidation, possesses coherence and thermal insulative character when heated to 900 C for over 10 minutes. In addition, once charring has occured, fabric thickness may be engineered to increase to twice its original value after exposures at 500 C and this will reduce to not less than 80 percent of this value after 10 minutes at 900 C. The novel barrier structure thus fills a performance range gap between the aramid/carbon and ceramic fabrics available. ESA

N93-21158# Renker G.m.b.H. und Co. K.G., Freiburg (Germany).
METALLIZATION AND SPUTTERING OF TEXTILES: PRECONDITIONS FOR THE SUBSTRATE, PROPERTIES AND APPLICATIONS
Johannes Weiss *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 270-276 (For primary document see N93-21129 07-24)
Copyright Avail: CASI HC A02/MF A03

A description of preconditions to the substrate in metallization and sputtering of textiles is given. The process, its capabilities as well as its problems, and the resulting properties, is described. In particular, for vacuum web coating of textiles, the same requirements plus a number of additional ones are shown to exist as for coating of film. The PVD process to be used depends on the application and the technical requirements and economic limits it sets up. The thickness measurements and their tolerances have to be defined mostly by other methods than used for film due to the three dimensional structure. The use of metallized textile is increasing. Having started with sunshields for windows it has meanwhile spread to medical applications and may in future serve as electrodes for galvanic and other applications. ESA

N93-21159# Wacker-Chemie G.m.b.H., Burghausen (Germany).
SILICONE SOFTENERS: TODAY
Peter Habereder and Hans-Juergen Lautenschlager *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 277-288 (For primary document see N93-21129 07-24)
Copyright Avail: CASI HC A03/MF A03

A discussion of softeners for textile finishing is presented. Aminofunctional silicone softeners dominate the textile market nowadays. Their main advantage, good softness, is accompanied by yellowing and hydrophobic effects. To overcome these problems, two new classes of silicone softeners are introduced: cyclohexylamino silicones as nonyellowing 'supersofteners'; sulfonato silicones with soft, antistatic, and hydrophilic properties. Properties of the silicones are detailed. A trial evaluation shows that the sulfonato silicane is an interesting specimen. ESA

N93-21160# Helsinki Univ. of Technology, Espoo (Finland).
OXIDE PROTECTIVE COATINGS ON CARBON COMPOSITES FOR MEDIUM AND HIGH-TEMPERATURE THERMAL CYCLING: NEW OPPORTUNITIES FOR THE UNITED EUROPE
Michael M. Gasik *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 296 (For primary document see N93-21129 07-24)
Copyright Avail: CASI HC A01/MF A03

Properties of oxide-ceramic coatings developed for application on carbon materials, in particular fiber reinforced composites, to protect them from oxidation during thermal cycling at medium (600 to 900 C) and high temperatures (up to 1400 C) in air flow, are reported. These alumina-zirconia based coatings have a high strength adhesion to the carbon substrate and matched thermal expansion coefficient. No chemical interaction was observed during thermal cycling. Due to its low porosity and high thermal stability as well as thermal shock resistance, it is possible to apply this kind of coating for heavy duty applications. Tests were performed for different types of composites mainly in aircraft (brake systems), and are to be carried out for space applications (e.g., nozzles, outlet pipes, and pipelines of solid fuel jet propulsion for high temperature shocks in oxygen environment leading to longer lifetime; thermal protection shields of a space shuttle in places of high loading, which will be allowed to be used many times; and using the coatings for high temperature joining of composites instead of metal rivets) as well. ESA

N93-21161# Technical Research Centre of Finland, Espoo. Fire Technology Lab.
CORRELATION OF RESULTS OF RADIANT HEAT TEST AND CONVECTIVE HEAT TEST FOR THREE LAYERED PROTECTIVE CLOTHING **c54**
Brita-Lisa Irjala, Djebar Baroudi, and Tanja Risikko *In its* Textiles and Composites 1992 1992 p 297-302 (For primary document see N93-21129 07-24)
Copyright Avail: CASI HC A02/MF A03

Research concerning the heat and flame protection of 120 three layered assemblies is reported. Three flame resistant fabrics were used as the upper layer, four materials were used as the inner layer, and the underclothing consisted of ten knitted mens underwear fabrics. The correlations between results of the radiant heat test in accordance with prEN 366 and convective heat tests in accordance with prEN 367 were calculated based on the fact that both methods are determining protection time units. The evaluation with a calculating program gave the equations S(sub 1) = a + bS(sub 2) for the correlations. The results show that there is a strong correlation between the results of the methods measuring the protection against radiant heat with 20 kW/sq m and convective heat assemblies where the uppermost layer is a non-melting fabric. ESA

N93-21162# Technical Research Centre of Finland, Espoo. Machine Automation Lab.
INFRARED IMAGING OF FIBRE REINFORCED PLASTIC COMPOSITES
Arto Laine *In its* Textiles and Composites 1992 1992 p 303-308 (For primary document see N93-21129 07-24)
(Contracts KAU-2206; KAU-10021; RAM-0024034)
Copyright Avail: CASI HC A02/MF A03

Plastic composite materials can be tested non-destructively using infrared imaging. IR-method uses heat flux to examine the inner structure of a test object. In a structure the defect conducts like an insulator. When the test object is heated from one side, the defect causes differences in the surface temperature. These local temperature differences above defects

can be located easily with a thermal camera. The thermal non-destructive testing (NDT) method is suitable for nearly all materials, and especially for plastic composites. It is a useful method, when subsurface and planar failures like delaminations and bonding failures are expected. This paper shows that delaminations in glass fiber reinforced thermoplasts can be detected with thermal NDT (Non-Destructive Tests). Detected delamination failures were confirmed by cutting the specimen and in one case by making use of ultrasonics. All major defects were found with thermal NDT. ESA

N93-21163# Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. fuer Konstruktion und Bauweisen.

KNITTED CARBON FIBER REINFORCED THERMOPLASTICS: STRUCTURAL CHARACTERIZATION WITH IMAGE ANALYSIS

J. Mayer, P. Luescher, and E. Wintermantel *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 315-320 (For primary document see N93-21129 07-24)

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Different image analysis procedures for the characterization of carbon fiber weft knittings as reinforcements were developed. This was done by analyzing the shape of the stitches related to the deformation state as well as the fiber orientation distribution in a ground section. The stitch analysis on one knit layer is done by subdividing and approximating the curved portions through short fiber segments with the following analyzing parameters: fiber orientation and length distribution in-plane. The analysis of the fiber cross sections in a ground sectioned specimen gives a spatial fiber orientation distribution. The in-plane stiffness data are calculated using a composite analyzing program, and the spatial stiffness distribution is calculated by the Krenchel approach. This data is correlated with preliminary experimental findings. It can be shown that the proposed image analyzing procedures for weft knittings are a valuable tool in mechanically characterizing knitting reinforcements of composites. ESA

N93-21164# Tartu State Univ. (USSR). Dept. of Chemistry.

ANALYSIS STRATEGY FOR ORGANIC BROMINE FLAME-RETARDANT COMPOUNDS AS ENVIRONMENTAL CONTAMINANTS

Lilli Paama, Heino Kokk, and Uno Maeeorg *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 321-325 (For primary document see N93-21129 07-24)

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The methods and results of ionometric, spectrophometric, and gas chromatographic determinations of OBFRC (Organic Bromine Flame Retardant Compounds) are presented. OBFRC are the important chemicals for synthetic textile polymers and decrease the flammability of rayon, polyester fibers, acrylic fibers, and rayon blends. The methods were applied for the determination of OBFRC in air and water for hygenic studies on toxicity and for monitoring the permissible concentrations in air of workplace. ESA

N93-21165# Tallinn Polytechnic Inst. (USSR).

NMR STUDY OF TRIAZONE COMPOUND FORMATION

Kadri Siimer, Holger Oja, Peep Christjanson, and Aart Laht (Academy of Sciences of the Estonian SSR, Tallinn.) *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 332-337 (For primary document see N93-21129 07-24)

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C-13 and H-1 NMR (Nuclear Magnetic Resonance) spectra were recorded to determine the extent of triazone (tetrahydro-1,3,5-triazine(1H) 2-one) formation and the pattern of ring substitution in urea-formaldehyde-ammonia systems prepared with different molar ratios. The most favored compound in the reaction mixture is the triazinone ring substituted with methylene urea at the amine nitrogen, especially in the case of the urea excess. On the occasion of the urea deficit with respect to ammonia, various triazone derivatives substituted at the amide nitrogens either with methylene or methylol groups are formed. ESA

N93-21166# Academy of Sciences of the Estonian SSR, Tallinn. Inst. of Chemical Physics and Biophysics.

THE USE OF 2D NMR SPECTROSCOPY IN THE ANALYSIS OF ISOMERIC POLYAMIDES

Tonis Pehk *In* Technical Research Centre of Finland, Textiles and Composites 1992 1992 p 338-342 (For primary document see N93-21129 07-24)

Copyright Avail: CASI HC A01/MF A03

A discussion on the use of C-13 NMR (Nuclear Magnetic Resonance) spectroscopy for analysis of polymers and results from H-1 and C-13 NMR spectra measurements are presented. Two dimensional (2D) correlations were obtained. H-1 and C-13 chemical shifts are reported. A comparison of the spectra of the polyamides and the correlations of the polyamides, including cross peaking, are shown. In summary, C-13 and H-1 spectra give the correct number of methylene groups between the amide bonds. The possibilities of different isomers from aliphatic polyamides must be always considered. The use of various 2D correlations is a useful tool for obtaining correct assignments of both H-1 and C-1 nuclei and determining the correct polyamide structure. ESA

N93-21289# European Space Agency, Paris (France).

PREDICTION OF DAMAGE OF LAMINATED COMPOSITE STRUCTURES UNDER QUASI-STATIC AND CYCLIC LOADINGS [PREVISION D'ENDOMMAGEMENT SOUS CHARGEMENTS QUASI-STATIQUES ET CYCLIQUES DES STRUCTURES COMPOSITES STRATIFIEES]

Alain Thionnet (Office National d'Etudes et de Recherches Aerospatiales, Paris, France.) Aug. 1992 260 p Transl. into English of Prevision d'Endommagement sous Chargements Quasi-Statiques et Cycliques des Structures Composites Stratifiees (Paris, France, ONERA), 1991 189 p Original language document was announced as N92-19906

(ESA-TT-1282; ONERA-NT-1991-4; ETN-93-93082) Avail: CASI HC A12/MF A03

Mechanisms of damage by ply cracking and free edge delamination in flat plate type laminated structures with unidirectional fiber plies are studied. The cracking of the plies, described by a single variable defined in terms of physical quantitites for the defect, is dealt with using two approaches: the first, meso-macro, is written in regard to the ply equivalent to the cracked ply in the damage mechanics sense; and the second micro-macro, is based on the statistical aspects of the phenomenon. In both cases, either under quasistatic loading, or under fatigue loading, the proliferation of the cracks in each ply of the structure is simulated. Delamination is studied when it spreads symmetrically in a laminated flat plate. The consequences of this damage on the generalized behavior of the structure, defined in the fracture mechanics sense, is evaluated. A model is then written using a thermodynamic formulation resulting in a rate equation for delamination. The analytical character of the model makes it possible to couple this global damage with the local damage due to the cracking in each ply of the structure, in the case of a smooth flat plate, and to observe the two modes of damage progressing and interacting continuously. In order to be able to study more complex structures, the models of two modes of damage are implemented in a finite element computational code employing an all or nothing type rate hypothesis for the delamination. Calculations carried out on perforated plates show a good trend in the prediction of damage zones. ESA

N93-21295# Aerospatiale, Paris (France).

TOUGHNESS OF Si3N4-SiC WHISKER COMPOSITES

E. Champion, P. Goursat, J. L. Besson (Limoges Univ., France.), V. Madigou (Pau Univ., France.), M. Monthioux (Pau Univ., France.), and P. Lespade (Aerospatiale Aquitaine, Saint-Medard en Jalles, France.) 1992 8 p

(Rept-921-430-118; ETN-93-91945) Avail: CASI HC A02/MF A01

Analysis of microstructural details of crack wake and fracture surface morphology was performed to assess the mechanisms involved in the toughening of ceramic matrices through the incorporation of whiskers. It was found that Si3N4-SiC whisker composites exhibit an R-curve behavior. This results from two different types of bridging regions in the crack wake: ligaments of unbroken material and, at a finer scale, whisker bridging. Provided the whiskers are big enough, a synergetic effect arises from these two phenomena. ESA

N93-21359# Ecole Centrale de Lyon (France). Dept. de Mecanique des Solides.

MULTILAYERED ELASTOPLASTIC HOMOGENEIZATION AND ANISOTROPIC PLASTICITY Ph.D. Thesis [HOMOGENEISATION ELASTOPLASTIQUE STRATIFIEE ET PLASTICITE ANISOTROPE]

Abderrahim ElOmri 1992 126 p In FRENCH

(ECL-92-24; ETN-93-93055) Avail: CASI HC A07/MF A02

The mechanical behavior of materials containing elastoplastic heterogeneities is studied. The multilayered composite material is composed of two phases presenting the following characteristics: homogeneous elasticity and heterogeneous plasticity. A method to study a multilayered polycrystal based on concepts of homogenization and texture is presented. The effects of the aggregate granular anisotropy are considered. The approach proposed to analyze a multilayer is based on the decomposition of the symmetric tensor space. This method can obtain a law to describe the mechanical behavior of each phase independently of the properties of the other existent phases. The approach is generalized, and a method to describe the macroscopic mechanical behavior of a multilayered material, independently of its microscopic characteristics, is presented. The concepts of decomposed homogenization and viscoplasticity can be included in the model. ESA

N93-21404# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).
COATINGS ON COMPOSITES: NEW DEVELOPMENTS AND APPLICATIONS IN THE AEROSPACE INDUSTRY
Richard Suchentrunk, C. Matz (Deutsche Airbus G.m.b.H., Bremen, Germany.), and Holbein (Dornier System G.m.b.H., Friedrichshafen, Germany.) 1992 29 p Presented at Surfair, Cannes, France, 3-4 Jun. 1992
(MBB-Z-0443-92-PUB; ETN-93-93444) Avail: CASI HC A03/MF A01

Methods of coating composite structures (glass, carbon, aramid fibers in epoxy, and PEEK and/or carbon matrix) with layers for different applications are described. By tailoring the surface properties of the technical requirements and economic needs, the following different methods are of major relevance: painting, electrochemical or electroless deposition, plasma or ion beam treatment, adhesive bonding of sheet or profiles, and chemical vapor deposition. These coating methods are discussed in relation to typical applications in the aerospace industry. Special attention is given to protection systems against lightning, wear and erosion, oxidation at elevated temperatures, and electric charging. The importance of specific pretreatment processes for the composite substrate and their influence in the quality of the systems coated are discussed, giving typical examples such as the treatment prior to painting or adhesive bonding. Possible methods of stripping and repairing coatings are also explained. ESA

N93-21457# Aerospatiale, Paris (France).
CARBON/CARBON AND CERAMIC COMPOSITES MADE BY AEROSPATIALE
B. Capdepuy (Aerospatiale Aquitaine, Saint-Medard en Jalles, France.) 1992 8 p Presented at DLR Conference, Stuttgart, Germany, 26 Nov. 1991
(Rept-921-430-106; ETN-93-91934) Avail: CASI HC A02/MF A01

Inorganic composites devoted to strategic and space applications are considered. The processing and properties of carbon/carbon and ceramic composites are considered. Present and future applications are discussed. ESA

N93-21458# Aerospatiale, Paris (France).
TESTING AND CHARACTERIZATION OF COMPOSITE MATERIALS BY COMPTON TOMODENSITOMETRY [CONTROLE ET CARACTERISATION DES MATERIAUX COMPOSITES PAR TOMODENSITOMETRIE COMPTON]
D. Babot (Institut National des Sciences Appliquees de Lyon, Villeurbanne, France.), C. LeFloch (Aerospatiale Aquitaine, Saint-Medard en Jalles, France.), and G. Peix (Institut National des Sciences Appliquees de Lyon, Villeurbanne, France.) 1992 10 p In FRENCH
(Rept-921-430-107; ETN-93-91935) Avail: CASI HC A02/MF A01

The Compton diffusion method is explained and examples of its use in measuring density and thickness of materials and in studying faults are given. This method uses x-rays produced by an industrial x-ray tube. It produced a three dimensional image of all types of materials without even touching the object. The x-ray tube and the detector are placed on the same side of the object. It is consequently possible to test a tank wall, even if the tank is full, since the rays do not need to traverse the object. ESA

N93-21462# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Unternehmensbereich Flugzeuge.
ALLOWABLE COMPRESSION STRENGTH FOR CFRP-COMPONENTS OF FIGHTER AIRCRAFT DETERMINED BY CAI-TEST
J. Bauer, Georg Guenther, and R. Neumeier 14 May 1992 10 p Presented at 74th AGARD Structures and Materials Panel Meeting, Patras, Greece, 24-29 May 1992
(MBB-FE-221-S-PUB-0483; ETN-93-93431) Copyright Avail: CASI HC A02/MF A01

Since reliable strength prediction methods are not yet available, a comprehensive test program was conducted utilizing a rather sophisticated test set up. This test set up was developed for a deeper examination of the influences from impact damages on the residual compression strength. The test procedure for Compression After Impact (CAI) is the so called 'Boeing test'. The test results data base formed the basis for the derivation of 'design allowables.' The test set up, the discovered mechanisms, and the derived 'design allowables' are presented. ESA

N93-21507# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
DEBONDING/DELAMINATION OF COMPOSITES [LE DECOLLEMENT ET LE DELAMINAGE DES MATERIAUX COMPOSITES]
Dec. 1992 289 p Presented at the 74th Meeting of the AGARD Structures and Materials Panel, Patras, Greece, 24-29 May 1992 Original contains color illustrations
(AGARD-CP-530; ISBN-92-835-0696-0) Copyright Avail: CASI HC A13/MF A03

Composite laminate components are prone to debonding/delamination when subjected to high interlaminar stress or when under impact. While delamination failure in itself is not usually catastrophic, its influence on a component may lead to subsequent failure modes. Hence debonding or delamination may reduce the strength of an aircraft or its fatigue life. The objective of the Specialists' Meeting, organized in the Spring of 1992, was to review the present state-of-the-art in the analysis, detection, and repair of delamination. Twenty-nine excellent papers were presented to an audience of over 100 leading specialists from NATO countries. Discussion of the papers presented and the final summary session revealed some common concerns and issues and gave rise to several recommendations. In bringing together the various experiences of air forces, governments, industries, and universities, the meeting has helped to identify the key issues. For individual titles, see N93-21508 through N93-21534.

N93-21508# Wright Lab., Wright-Patterson AFB, OH.
FREE EDGE DELAMINATION PREVENTION IN COMPOSITE LAMINATES
N. J. Pagano and S. R. Soni (Adtech Systems Research, Inc., Dayton, OH.) *In* AGARD, Debonding/Delamination of Composites Dec. 1992 11 p (For primary document see N93-21507 07-24)
Copyright Avail: CASI HC A03/MF A03

The key to success in the prevention of free edge delamination is the understanding of stress components and contributing factors responsible for the onset of delamination. The contributing factors may be fiber/matrix properties, ply orientations, and stacking sequence. In the past two decades the authors have done extensive theoretical and experimental investigations on this topic. As a result of their continuous work in this area a unique software package, 'Automated System for Composite Analysis' was developed. The effectiveness of the Automated System for Composite Analysis (ASCA) for identifying the contributions of the influencing factors responsible for the onset of delamination and help select safer configurations. For this purpose two material systems (one polymer matrix composite AS4/3501 and one metal matrix composite SCS6/Ti) were considered. These two composites represent highly orthotropic and near quasi-isotropic material properties. Author

N93-21509# Army Aerostructures Directorate, Hampton, VA.
DELAMINATION AND FATIGUE OF COMPOSITE MATERIALS: A REVIEW
T. K. OBrien and W. Elber *In* AGARD, Debonding/Delamination of Composites Dec. 1992 11 p (For primary document see N93-21507 07-24)
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Research exploring the role of delamination on the durability and damage

tolerance of advanced composite materials is reviewed. Recent studies on the characterization of composite delamination are summarized. Recent analytical solutions for interlaminar stresses and strain energy release rates associated with common sources of delamination are also reviewed. The role of delamination in (1) low velocity impact, (2) residual compression strength, and (3) fatigue is highlighted. Delamination is shown to be the common damage mode observed in all of these problems. A Damage Threshold/Fail-safety concept for addressing composite damage tolerance is discussed. Author

N93-21510# Wright Lab., Wright-Patterson AFB, OH. Structures Div.
INITIATION AND PREVENTION OF EDGE DELAMINATION WITH AND WITHOUT RESIDUAL STRESSES
R. S. Sandhu, G. P. Sendeckyj, G. A. Schoeppner, and J. E. Pappas *In* AGARD, Debonding/Delamination of Composites Dec. 1992 20 p (For primary document see N93-21507 07-24)
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The total delamination moment (DM) is shown to be a quantitative criterion for predicting delamination initiation in composite laminates near free edges. To determine the initiation of delamination near free edges, DM of the laminate is compared to the critical delamination moment obtained experimentally. Specially designed specimens incorporating variable radius geometries are used to determine the critical DM. The analytical technique coupled with the experimental data is used to minimize the tendency of the laminates to delaminate without increasing the designed thickness of the laminates. In addition, residual curing stresses are included in the analytical technique to determine their effect on the initiation of edge delamination. Author

N93-21511# Brussels Univ. (Belgium). Composite Systems and Adhesion Research Group.
NUMERICAL ANALYSIS OF THE THERMOELASTIC EFFECTS IN LAMINATED STRUCTURES AND ITS USE IN THE IDENTIFICATION OF DEFECTS
D. VanHemelrijck, L. Schillemans, P. DeWilde, A. Cardon, M. Kyriakopoulos (Patras Univ., Greece.), and G. Roupakias (Patras Univ., Greece.) *In* AGARD, Debonding/Delamination of Composites Dec. 1992 6 p Sponsored in part by Belgian National Foundation for Scientific Research (For primary document see N93-21507 07-24)
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The thermoelastic effect first analyzed by Lord Kelvin is governed by a simple relation between amplitude of temperature and amplitude of sum of principle stress change as long as adiabatic conditions are maintained. Although valid for isotropic materials it is shown that this simple relation leads to very poor results for anisotropic materials. A non-adiabatic theory taken into account the inter-laminar heat transfer shows a better agreement between theory and experiment. Experimental data were obtained on a Fibredux 914C-TS-5-34 percent carbon epoxy laminate using single point measurements. Author

N93-21512# Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.
PREDICTING FAILURE BY DEBONDING/DELAMINATION
G. A. O. Davies and P. Robinson *In* AGARD, Debonding/Delamination of Composites Dec. 1992 28 p Sponsored by Commission of the European Communities and Defence Research Agency (For primary document see N93-21507 07-24)
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The need for predicting delamination or debonding in carbon fiber composite structures in two situations where the effect is crucial is highlighted. First, interior barely visible damage due to low velocity impact is discussed, and second, the debonded joint between panel and stiffener in a post-buckled compression panel is addressed. It is shown that for impact damage a stress-based failure criteria might work for thin plates less than 2mm thick but as the thickness increases a fracture model becomes necessary. A strategy for bridging this gap and also avoiding the need for a hypothetical flaw is advocated. An improved method for finding mode 3 fracture toughness is shown. Author (revised)

N93-21513# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Inst. for Structural Mechanics.
GARTEUR DAMAGE MECHANICS FOR COMPOSITE MATERIALS: ANALYTICAL/EXPERIMENTAL RESEARCH ON DELAMINATIONS
M. Gaedke, D. J. Allman (Royal Aircraft Establishment, Farnborough, England.), C. Czekajski (Aerospatiale, Toulouse, France.), H. Eggers, D. Giletta (Office National d'Etudes et de Recherches Aerospatiales, Paris, France.), R. Girard (Office National d'Etudes et de Recherches Aerospatiales, Paris, France.), R. Hillgert (Messerschmitt-Boelkow-Blohm G.m.b.H., Munich, Germany.), J. Lameris (National Aerospace Lab., Amsterdam, Netherlands.), R. F. Mosley (Aerospatiale, Toulouse, France.), and R. T. Potter (Aerospatiale, Toulouse, France.) *In* AGARD, Debonding/Delamination of Composites Dec. 1992 11 p (For primary document see N93-21507 07-24)
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Currently used carbon fiber reinforced plastics (CFRP) - mainly with epoxy matrices - show a sensitive reaction to impact damage which stimulated the establishment of a cooperation program within GARTEUR (Group of Responsibles for Structures and Materials). Studies in this field had shown that delamination is a critical damage in this area for airframe structures with principal points of concern of tendency of buckling of delaminated areas and potential growth of delaminations. Author (revised)

N93-21514# Aerospatiale, Paris (France). Joint Research Center.
BUCKLING AND POST-BUCKLING BEHAVIOR OF A DELAMINATION IN A CARBON-EPOXY LAMINATED STRUCTURE: EXPERIMENTS AND MODELLING
D. Guedra-Degeorges, S. Maison, D. Trallero, and J. L. Petitniot (Institut de Mecanique des Fluides de Lille, France.) *In* AGARD, Debonding/Delamination of Composites Dec. 1992 11 p Sponsored by Ministry of Defence (For primary document see N93-21507 07-24)
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Results for the following studies are presented: (1) experimental identification of sensitivity to local buckling and characterization of post buckling behavior of a delamination in a plate under compression; and (2) performing nonlinear three dimensional finite element computations in order to establish local buckling loads, shape of the blister, load levels, and direction related to the propagation of the delamination. Author (revised)

N93-21515*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PROGRESSIVE DELAMINATION IN POLYMER MATRIX COMPOSITE LAMINATES: A NEW APPROACH
C. C. Chamis, P. L. N. Murthy, and L. Minnetyan (Clarkson Univ., Potsdam, NY.) *In* AGARD, Debonding/Delamination of Composites Dec. 1992 9 p (For primary document see N93-21507 07-24)
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A new approach independent of stress intensity factors and fracture toughness parameters has been developed and is described for the computational simulation of progressive delamination in polymer matrix composite laminates. The damage stages are quantified based on physics via composite mechanics while the degradation of the laminate behavior is quantified via the finite element method. The approach accounts for all types of composite behavior, laminate configuration, load conditions, and delamination processes starting from damage initiation, to unstable propagation, and to laminate fracture. Results of laminate fracture in composite beams, panels, plates, and shells are presented to demonstrate the effectiveness and versatility of this new approach. Author

N93-21516# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
DELAMINATION DAMAGE AND ITS EFFECT ON BUCKLING OF LAMINATED CYLINDRICAL SHELLS
R. C. Tennyson and S. Krishna Kumar *In* AGARD, Debonding/Delamination of Composites Dec. 1992 6 p (For primary document see N93-21507 07-24)
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The task of the project engine designer is to determine what type, size and arrangement of propulsion system is best suited to any particular aircraft requirement. This task involves a compromise between many aspects, notably between engine or installation, performance and weight, and also, nowadays, cost as well. This compromise has to be achieved within the

known or projected state of the art in thermodynamic and aerodynamic design, mechanical and structural design, and the way in which these design arts react upon each other. Most studies in engine design commence with a parametric study of the main thermodynamic variables, i.e., pressure ratio, turbine entry temperature (TET) and by-pass ratio, and their effect on specific fuel consumption (sfc) and specific thrust. This study will be based upon a given level of component efficiency which will reflect the aerodynamic state of knowledge which is considered appropriate to the estimated service date of the engine or propulsion system.

Derived from text

N93-21517# Alenia Aeronautica, Torino (Italy). Materials Technology Dept.

FRACTURE ANALYSIS OF BMI SYSTEM IN PRESENCE OF MOISTURE

G. Barbiso and M. R. Boccuti *In* AGARD, Debonding/Delamination of Composites Dec. 1992 9 p (For primary document see N93-21507 07-24)

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Working with today's composite materials not predicted phenomena mainly related to the matrix chemical behavior can occur. Delaminations on solid laminate and honeycomb structure using a bismaleimide (BMI) resin have been detected. Analysis of the delaminated parts have been carried out to understand the nature of the defect. Correlation of the chemical behavior affecting the mechanical properties and the solution to overcome the delamination problems are described. Author

N93-21518# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

MODELISATION AND COMPUTATION OF COMPOSITE MATERIALS

Georges Duvaut *In* AGARD, Debonding/Delamination of Composites Dec. 1992 5 p Prepared in cooperation with Paris VI Univ., France (For primary document see N93-21507 07-24)

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Composite materials are more and more widely used in aeronautical and spacial engineering and industry. Their main advantage is the gain in weight but it is not the only one: noncorrosion and their ability to assume complex functions without bearings are also very valuable in some cases. The drawback is the difficulty to predict their behavior and write valuable constitutive relations to perform structure computations. This is due to the microscopic heterogeneities and the various phases and interfaces whose behavior is not well-known. In this paper, we propose a homogenization method which allows, when the microscopic structure can be assumed periodic at some intermediate scale, to build a constitutive relation from the assumed knowledge of the behavior of the various phases and interfaces. Author

N93-21519# Institute for Aerospace Research, Ottawa (Ontario).

EDGE DELAMINATION OF COMPOSITE LAMINATES

C. Poon, N. C. Bellinger, Y. Xiong, and R. W. Gould *In* AGARD, Debonding/Delamination of Composites Dec. 1992 13 p Sponsored by De Havilland Aircraft Co. of Canada Ltd. (For primary document see N93-21507 07-24)

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A review of the literature and the research performed at the Institute for Aerospace Research on the subject of delamination in composite laminates are presented. Delamination is known to initiate at free edges where the influence of interlaminar stresses is significant. These interlaminar stresses are three dimensional and cannot be calculated by the laminated plate theory. State-of-the-art stress analysis methods for interlaminar stresses are reviewed with emphasis on the reliability of finite element methods. The strength of materials and fracture mechanics approaches for the prediction of delamination onset and growth are discussed. Results of edge delamination, double cantilever beam, and end notch flexure tests for toughened resin composites are presented. The effects of delamination on structural integrity are investigated by conducting cyclic tests on bread board specimens representing the bolted joint interface between the ply build-up ends of the composite arm booms and the metallic flanges of a sophisticated robotic system for space application. The onset of delamination at the curved edge of an open hole under compressive loading is detected using acoustic emission techniques and penetrant-enhanced x-radiography. The effects of impact-induced delaminations on the residual compressive strength of composite laminates are predicted using a model based on sublaminate buckling. Preliminary verification of the model shows good agreement between experimental and predicted results. Author

N93-21520# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (Germany). Inst. fuer Strukturmechanik.

SYNERGISM BETWEEN LAYER CRACKING AND DELAMINATIONS IN MD-LAMINATES OF CFRE

H. Eggers, H. C. Goetting, and H. Baeuml *In* AGARD, Debonding/Delamination of Composites Dec. 1992 9 p (For primary document see N93-21507 07-24)

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The synergism between successive layer cracking and delamination growth was studied for laminates fabricated out of T300/914C solely. Unidirectional (UD) and fiber dominated multidirectional (MD) laminates were tested after static or fatigue loading. Typical examples for damage mechanisms were analyzed numerically and used to develop damage conditions. An increase of the damage resistance was observed for MD-laminates stacked by quasi-unidirectional (plus or minus 2)-double layers (QD-layers). In crossply laminates of various stacking sequences, the crack distances were measured on the inner 90 degree-layers after T-fatigue loading. Expressions for the mean crack distances and the residual layer stiffness were developed in dependence of layer thicknesses, mean layer strain epsilon perpendicular to the fibers and number of load cycles. For the Characteristic Damage State (CDS) an energy condition was established to evaluate the crack distances A(sub CDS) for brittle matrices. In order to describe more properly the delamination growth interferred by layer cracking, a second order tensor was established for the released energy. The mean values of this tensor are the common energy release rates (ERR) for the different crack modes and the first invariant is the total ERR. But the ERR-tensor has three invariants, which can be used to establish more complex damage conditions. Author

N93-21521# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (Germany). Inst. for Structures and Design.

DELAMINATION DEVELOPMENT UNDER FATIGUE LOADING

R. M. Aoki and J. Heyduck *In* AGARD, Debonding/Delamination of Composites Dec. 1992 7 p (For primary document see N93-21507 07-24)

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Examples of delamination development in carbon-fiber reinforced plastic (CFRP) impact damaged specimens and structural parts under tensile and compressive fatigue loading investigated with the help of the ultrasonic in-situ (USIS) method are presented. The evaluation of the ultrasonic rear echo shows the manifold ways of delamination development depending on materials used, configuration of specimens, as well as loading conditions.

Author

N93-21522# Vrije Univ., Brussels (Belgium). Analyse van Strukturen.

NUMERICAL FINITE ELEMENT ANALYSIS OF DAMAGE USING MONTE CARLO TECHNIQUES **c64**

G. VanVinckenroy and W. P. DeWilde *In* AGARD, Debonding/Delamination of Composites Dec. 1992 6 p Sponsored by Ministry of Economic Affairs; Science Policy Dept. and Belgian National Foundation for Scientific Research (For primary document see N93-21507 07-24)

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A method, based on the finite element technique, is proposed in order to study the behavior of an adhesive single lap joint, together with stochastic material properties, taking into account the uncertainties of design parameters. The technique is applicable to linear and nonlinear problems, with more or less complicated structures. The needs are experimental determination of the components properties and numerical tools.

Author (revised)

N93-21523# Royal Aerospace Establishment, Farnborough (England).

MODE 2 DAMAGE DEVELOPMENT IN CARBON FIBRE REINFORCED PLASTICS

M. J. Hiley and P. T. Curtis *In* AGARD, Debonding/Delamination of Composites Dec. 1992 11 p Sponsored by Ministry of Defence (For primary document see N93-21507 07-24)

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A study of the mode 2 interlaminar fracture toughness of unidirectional

carbon fiber reinforced plastics has been made using the End Notched Flexure (ENF) test. A range of fiber reinforced thermosetting prepreg systems including a bismaleimide and four epoxy materials have been investigated, plus the thermoplastic PEEK. A comparison between the materials showed the thermoplastic to be significantly tougher than any of the thermosetting systems. The two phase epoxy system 914 and the BMI V390 had the lowest toughness, with values of only 20 percent of those of the APC2 PEEK. The potential link between mode 2 fracture toughness and delamination growth and impact damage tolerance has been assessed. Measurements of delamination growth in mode 2 fatigue, for three of the materials, have also been made. Potential links with the materials susceptibility to the growth of delaminations and more generally impact damage during fatigue loading have also been considered. Author

N93-21524# Wright Lab., Wright-Patterson AFB, OH. Flight Dynamics Directorate.

BARELY VISIBLE DAMAGE THRESHOLD IN A BMI

Edvins Demuts and Raghbir S. Sandhu *In* AGARD, Debonding/Delamination of Composites Dec. 1992 6 p (For primary document see N93-21507 07-24)

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This paper presents the test plan, equipment and procedures employed and results obtained in an experimental investigation of IM7/5260 graphite bismaleimide's resistance to low velocity impact. The two velocities used were approximately 15 ft/sec for the four groups of thicker and approximately 10 ft/sec for the group of the thinnest specimens. The planform dimensions of the specimens were 7 in. x 10 in. The effect of two different layups 10/80/10 and 40/50/10 (percent of 0 degree/plus or minus 45 degree/90 degree plies) on impact resistance was investigated. There were five thicknesses for the 10/80/10 layup - 9, 26, 48, 74, 96 plies and four thicknesses for specimens of the 40/50/10 layup - 9, 27, 49, 73 plies. Four replicates were used for each combination of layup and thickness. Specimens were impacted by a free-falling steel impactor of 1 in. diameter and with a hemispherical end. During impact, specimens were sandwiched between a 1 in. thick steel bottom plate and a 0.25 in. thick aluminum plate, clammped by four corner bolts. Both plates had a central 5 in. x 5 in. opening whose center was aligned with those of the specimen and the impactor. The impactor, upon rebound, was caught thus avoiding subsequent impact. The resulting dent depths were measured with a dial gage and an ultrasonic through transmission method determined the damaged area extent. All testing was performed at room temperature. Specimens were not moisture preconditioned. Author

N93-21525# Thrace Univ., Xanthe (Greece). School of Engineering.

THE INFLUENCE OF PARTICLE/MATRIX DEBONDING ON THE STRESS-STRAIN BEHAVIOR OF PARTICULATE COMPOSITES

E. E. Gdoutos *In* AGARD, Debonding/Delamination of Composites Dec. 1992 9 p (For primary document see N93-21507 07-24)

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A mathematical model to predict the nonlinear stress-strain behavior of particulate composites is proposed. The model consists of a rigid circular or square inclusion embedded in a matrix across part of its boundary, while the remaining part forms an interfacial crack. The stress field in the composite plate is determined by using the theory of complex potentials in conjunction with the conformal mapping technique. The local stress field in the vicinity of the crack tip is of mixed-mode and it is governed by the values of the opening-mode and sliding-mode stress intensity factors. Initiation of debonding along the inclusion/matrix interface and growth of the interfacial crack is studied by using the maximum circumferential stress criterion. It is shown that the nonlinear behavior of the stress-strain diagram of particulate composites can be explained by studying the stable growth of the interfacial crack along the inclusion boundary. Author

N93-21526# Patras Univ. (Greece). Dept. of Mechanical Engineering.

IDENTIFICATION OF DELAMINATION BY EIGENFREQUENCY DEGRADATION: AN INVERSE PROBLEM

B. Stamos, V. Kostopoulos, and S. A. Paipetis *In* AGARD, Debonding/Delamination of Composites Dec. 1992 7 p (For primary document see N93-21507 07-24)

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The free vibrations of a delaminated composite beam is investigated. The effect of interply delaminations on the eigenfrequencies of the beam is evaluated both analytically and numerically in the general case of an asymmetric laminate with a delamination of arbitrary size and location. Coupling between longitudinal and bending motion is considered, which affects the natural frequencies of the delaminated beam significantly. In general the delamination causes the even numbered vibration modes to degrade, e.g. to decrease, faster than the odd ones. An inversion method to determine position and size of the delamination is proposed, based on the degradation of the first two natural frequencies. Author

N93-21527# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).

INVESTIGATION OF THE BOND STRENGTH OF A DISCRETE SKIN-STIFFENER INTERFACE

H. G. S. J. Thuis and J. F. M. Wiggenraad *In* AGARD, Debonding/Delamination of Composites Dec. 1992 9 p (For primary document see N93-21507 07-24)

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This paper presents the results of an experimental study on the effects of several design parameters on the strength of a skin-stiffener interface. Design parameters which are considered are skin and stiffener laminate properties and the width of the bond layer. Test specimens consisting of a blade type stiffener secondarily bonded to skin laminate were fabricated. The specimens were tested by lateral tension tests, four-point bending tests and pull off tests. Calculations were made with the numerical program BONDST. The test results are compared with each other and with the calculated results. Conclusions are drawn and design guidelines are provided. Author

N93-21528# Brussels Univ. (Belgium). Composite Systems and Adhesion Research Group.

DEFECT ANALYSIS USING ADVANCED INTERPRETATION OF THE REFLECTED WAVE DURING ULTRASONIC SCANNING c38

L. Schillemans, D. VanHemelrijck, F. DeRoey, W. P. DeWilde, A. H. Cardon, and A. A. Anastassopoulos *In* AGARD, Debonding/Delamination of Composites Dec. 1992 17 p Sponsored by Belgian National Foundation for Scientific Research Prepared in cooperation with Patras Univ., Greece (For primary document see N93-21507 07-24)

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The paper reports recent developments in the field of the interpretation of the form of the reflected wave during ultrasonic scanning of laminated plates. Defect analysis in laminated plates can be achieved by installing a threshold value on the amplitude of the reflected ultrasonic wave. If this threshold value has not been achieved, one considers that a defect is causing scatter and the location is registered as such. This is the most elementary form of measuring technique, although it does not provide more detailed information about the depth location of the defect. Nevertheless, it already provides some information, although rather 'binary'. On the used USIP 12 equipment (Krautkramer) a depth-measurement module was added allowing to establish the location of wave scatter through the thickness of the laminated structure. Recently, it has been suggested that the form of the reflected wave could yield some additional information on the types of defects. In particular, the frequency content of the reflected wave could be analyzed and be compared for different sorts of defects, thus allowing for a more accurate diagnostic of the defect and its significance. Advanced signal processing and pattern recognition techniques are therefore applied. Two Carbon/Epoxy laminated plates with several embedded defects have been manufactured and tested. Representative results will be given. Author

N93-21529# Hellenic Aerospace Industry, Schimatari (Greece). Advanced Materials, Processes and Manufacturing Lab.

DAMAGE DETECTION BY ACOUSTO-ULTRASONIC LOCATION (AUL) c38

Z. P. Marioli-Riga, A. N. Karanika, T. P. Philippidis (Patras Univ., Greece.), and S. A. Paipetis (Patras Univ., Greece.) *In* AGARD, Debonding/Delamination of Composites Dec. 1992 3 p (For primary document see N93-21507 07-24)

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Damage detection in aircraft structures in-situ is important, especially with not visible defects in composite components for a variety of reasons. In the present paper a new technique based on the Acousto-Ultrasonic (AU) concept is introduced, but instead of extracting information from the

externally generated pulsed wave, as with AU, the characteristics of waves reflected from defects are measured. In this way it was possible to identify and locate defected areas in honeycomb panels and thermoplastic carbon fiber laminates. The results were correlated with ultrasonic C-scans, and satisfactory agreement was obtained. The present is part of a major project aiming at the development of a fast inspection method for aircraft components during routine maintenance cycles. Author

N93-21530# Bristol Univ. (England). Dept. of Aerospace Engineering.
PREDICTION OF DELAMINATION IN TAPERED UNIDIRECTIONAL GLASS FIBRE EPOXY WITH DROPPED PLIES UNDER STATIC TENSION AND COMPRESSION
Michael R. Wisnom *In* AGARD, Debonding/Delamination of Composites Dec. 1992 7 p Sponsored in part by Westland Helicopters Ltd. (For primary document see N93-21507 07-24)
(Grant SRC-GR/G19572)
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The mechanism of delamination in tapered unidirectional specimens with dropped plies is discussed. Results from six sets of static tests with different numbers of dropped and continuous plies are presented. Specimens with 2 dropped/4 continuous, 2 dropped/8 continuous, and 6 dropped/4 continuous plies were tested in tension, and specimens with 2 dropped/16 continuous, 2 dropped/32 continuous, and 4 dropped/32 continuous plies were tested in compression. In all cases failure occurred by delamination into the thick section both above and below the dropped plies. Results are compared with predictions from a simple formula based on the strain energy release rate associated with the terminating plies, with the fracture energy determined from tension tests on a unidirectional specimen with cut central plies. Good correlation was found, and this approach is recommended as a design method for predicting delamination in tapered sections. Author (revised)

N93-21531# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).
ALLOWABLE COMPRESSION STRENGTH FOR CFRP-COMPONENTS OF FIGHTER AIRCRAFT DETERMINED BY CAI-TEST
J. Bauer, G. Guenther, and R. Neumeier *In* AGARD, Debonding/Delamination of Composites Dec. 1992 6 p (For primary document see N93-21507 07-24)
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A test set-up was developed for CAI tests allowing coupon sizes from 300 x 100 up to 300 x 250 mm and thicknesses from 4 to 8 mm. The test set-up was approved to measure the residual compression strength after impact in accordance with other test methods e.g. the 'Boeing Test' and 4-point bending boxes. The test set-up is applicable for the investigation of all relevant test parameters and provides in addition to current test procedures the possibility to vary the geometric dimensions, width and thickness, in a wide comfortable range. This performance emphasizes its application for data collection and subsequent Design Allowables derivation. The experience with the Damage Tolerance aspects during the development of a fighter aircraft demonstrates that it is possible to introduce and consider impact requirements in the structural design phase. Author (revised)

N93-21532# Defence Research Establishment Pacific, Victoria (British Columbia).
REPAIRING DELAMINATIONS WITH LOW VISCOSITY EPOXY RESINS
A. J. Russell and C. P. Bowers (National Defence Headquarters, Ottawa, Ontario.) *In* AGARD, Debonding/Delamination of Composites Dec. 1992 10 p (For primary document see N93-21507 07-24)
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Although resin injection is the procedure most often specified for repairing delaminations, field experience as well as numerous experimental investigations have shown it to be unreliable and in many cases ineffective. This paper identifies some of the reasons for this and then goes on to describe the successful development of an epoxy resin specially formulated for delamination repair. The ability of this resin to fully restore the out-of-plane properties of delaminated carbon/epoxy laminates is demonstrated, and some of the more practical aspects of repairing delaminations both on and off aircraft are discussed. Author (revised)

N93-21533# Dornier Luftfahrt G.m.b.H., Friedrichshafen (Germany).
NUMERICAL DETERMINATION OF THE RESIDUAL STRENGTH OF BATTLE DAMAGED COMPOSITE PLATES
T. Schneider, J. Moews, and M. Rother *In* AGARD, Debonding/Delamination of Composites Dec. 1992 16 p Sponsored by Ministry of Defence Original contains color illustrations (For primary document see N93-21507 07-24)
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High energy impact damage by projectiles is a permanent threat to all aircraft or helicopters in combat situations. Besides the actual damage extent, caused by the incident, and its effect on airworthiness, the question of the residual strength of the damaged structure arises. Based on the experimental findings on the damage extent in shot-affected APC2/AS4 composite plates, a theoretical prediction of the residual compressive strength is given in terms of strength, stability, and fracture mechanics principles. These predictions are compared with test results from four specimens, which were cut out from the original plates. It will be shown, that the delaminations, caused by the high energy impact, triggered the final compressive failure of the specimens with the start of an unstable delamination growth and that this event can be correctly predicted by a numerical analysis, if local out-of-plane deformations are taken into account. Author (revised)

N93-21534# Deutsche Airbus G.m.b.H., Bremen (Germany).
EFFECT OF IMPACTS ON CFRP STRUCTURES, RESULTS OF A COMPREHENSIVE TEST PROGRAM FOR PRACTICAL USE
I. Kroeber *In* AGARD, Debonding/Delamination of Composites Dec. 1992 10 p Sponsored in part by Volkswagen Foundation (For primary document see N93-21507 07-24)
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An experimental investigation was performed to establish the influence of impacts on the medium-tough CFRP material Ciba 6376/HTA. The results of this program enable a designer to dimension CFRP components. The compressive strain during impact was determined as a function of impact and impact energy. Slight increases of this compressive strain above a certain threshold resulted in catastrophic failure. Furthermore the influence of the thickness on residual strength and visible damage threshold is given. It was found, that the allowable strain limit not only depends on the impact energy but also on the laminate lay-up, especially the proportion of 0 degree-plies. Drop weight impacts show lower C-Scan damage areas compared with air gun impacts. However, the residual strain is the same in both cases. As opposed to coupons, stringer stiffened panels result in a scale-up effect of 15 percent concerning the allowable strain limit. However, this effect might change for different geometries. Author (revised)

N93-21838# Los Alamos National Lab., NM.
DIFFRACTION MEASUREMENTS OF RESIDUAL STRESS IN TITANIUM MATRIX COMPOSITES
M. R. James (Rockwell International Science Center, Thousand Oaks, CA.), M. A. Bourke, J. A. Goldstone, and A. C. Lawson 1992 9 p Presented at the Annual Meeting of The Metallurgical Society, Denver, CO, 21-25 Feb. 1993
(Contract W-7405-eng-36)
(DE93-003855; LA-UR-92-3831; CONF-930202-3) Avail: CASI HC A02/MF A01

Metal matrix composites develop residual strains after consolidation due to the thermal expansion mismatch between the reinforcement fiber and the matrix. Neutron and x-ray diffraction measured values for the longitudinal residual stress in the matrix of four titanium MMC's are reported. For thick composites (greater than 6 plies) the surface stress measured by x-ray diffraction matches that determined by neutron diffraction and therefore represents the stress in the bulk region consisting of the fibers and matrix. For thin sheet composites, the surface values are lower than that in the interior and increase as the outer rows of fibers are approached. While a rationale for the behavior in the thin sheet has yet to be developed, accounting for composite thickness is important when using x-ray measured values to validate analytic and finite element calculations of the residual stress state. DOE

N93-21842# Georgia Tech Research Inst., Atlanta.
POLYORGANOSILAZANE PRECERAMIC BINDER DEVELOPMENT FOR REACTION BONDED SILICON NITRIDE COMPOSITES
D. L. Mohr and T. L. Starr Nov. 1992 24 p Prepared in cooperation with Georgia Tech Research Inst., Atlanta, GA

(Contract DE-AC05-84OR-21400)
(DE93-004063; ORNL/Sub-87-00184/03) Avail: CASI HC A03/MF A01

The use of two commercially available polyorganosilazanes for application as preceramic binders in a composite composed of silicon carbide fibers in a reaction bonded silicon nitride (RBSN) matrix are examined. Ceramic monolithic and composite samples were produced. Density of monolithic and whisker reinforced RBSN samples containing the polysilazane binder was increased. Mercury intrusion porosimetry revealed a significant decrease in the pore sizes of samples containing a polyorganosilazane binder. Electron micrographs of samples containing the preceramic binder looked similar to control samples containing no precursor. Overall, incorporation of the polysilazane into monolithic and whisker reinforced samples resulted in significantly increased density and decreased porosity. Nitriding of the RBSN was slightly retarded by addition of the polysilazane binder. Samples with the preceramic binders contained increased contents of alpha versus beta-silicon nitride which may be due to interaction of hydrogen evolved from polysilazane pyrolysis with the nitriding process. Initial efforts to produce continuous fiber reinforced composites via this method have not realized the same improvements in density and porosity which were observed for monolithic and whisker reinforced samples. Further, the addition of preceramic binder resulted in a more brittle fracture morphology as compared to similar composites made without the binder. DOE

N93-21989# Lawrence Livermore National Lab., CA.
ROLE OF POROSITY IN ESTIMATES OF COMPOSITE ELASTIC CONSTANTS
J. G. Berryman Oct. 1992 29 p Presented at the Symposium on Composite Material Technology, Houston, TX, 31 Jan. - 3 Feb. 1993
(Contract W-7405-eng-48)
(DE93-002887; UCRL-JC-112024; CONF-930154-1) Avail: CASI HC A03/MF A01

The presence of small amounts of residual void space (on the order of one percent by volume) is sufficient to make estimates of composite elastic constants (obtained while ignoring this porosity) violate the Hashin-Shtrikman bounds in many cases. Experimental values falling below the incorrectly estimated lower bound is the normal direction of violation, but erroneous neglect of porosity in 'pure' samples can also lead to experimental values rising above the incorrectly computed upper bound. Examples are presented to illustrate the nature of the error and methods of correcting it for data on composite ceramics. The result is improved agreement between the Hashin-Shtrikman bounds, effective medium theory estimates, and experimental data. DOE

N93-20623# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
ADVANCED INDUSTRIAL MATERIALS. AN OVERVIEW
R. C. Tennyson *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 88-93 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20624# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
SMART MATERIALS
Raymond M. Measures *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 94-96 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20625# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
THERMOPLASTIC COMPOSITES
W. J. Unger, H. Y. S. Ko, and J. S. Hansen *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 98-101 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20633# Institut National des Sciences Appliquees, Toulouse (France).
A VARIATIONAL APPROACH FOR TORSION OF MULTIPLY CONNECTED COMPOSITE SECTIONS
R. A. Daoud and E. Ramahefarison *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 160-161 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20634# Obafemi Awolowo Univ., Ile-Ife (Nigeria). Dept. of Mathematics.
ON HOMOGENIZATION METHOD AND LARGE DEFORMATIONS
A. Akinola *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 162-163 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-21106# Electrofuels Mfg. Co., Toronto (Ontario).
STUDIES OF DISPERSED PHASE SYSTEMS: OSTWALD RIPENING AND METAL MATRIX COMPOSITES
C. B. Alcock, A. McLean, J. Butler, S. Das Gupta, J. Jacobs, and A. Majumdar *In* Canadian Space Agency, Spacebound 1991 1991 p 191-194 Prepared in cooperation with Toronto Univ., Ontario (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N93-20021# Minnesota Mining and Mfg. Co., Saint Paul. Corporate Research Labs.
DUAL CURE SOLVENTLESS COATING PROCESS
Oct. 1992 107 p
(Contract DE-AC04-88ID-12692)
(DE93-001351; DOE/ID-12692/2) Avail: CASI HC A06/MF A02

The objective of 3M's contract is to develop dual cure photocatalyst technology for the reduction of gaseous waste emissions through the minimization of coating solvent use. This is to be accomplished by developing a photocuring technology that would allow the use of solvent free (100 percent solids) formulations while preserving or improving upon the performance of conventional solvent based materials. Phase 2 focused on development of the engineering steps required to transfer this technology from the laboratory to pilot plant scale applications. Preparation of commercially significant quantities of photocatalyst was demonstrated in this phase. Dual cure target applications were also evaluated. These utilized both urethane/acrylate and epoxy/acrylate compositions. The ability to cure both clearcoat and pigmented compositions in air with visible light under mild conditions was shown. The cured materials were evaluated for their physical properties and enhanced performance was observed in comparison to the separate components. Significant reduction in volatile organic compound (VOC) emissions was shown. In selected applications a reduction in VOC from 650 gm/L to less than 100 gm/L may be achieved. The chemistry of catalyst activation was also explored. Cost, economic, and energy analyses conducted during Phase 1, were updated based on the new information obtained in Phase 2. DOE

N93-20051# Rice Univ., Houston, TX. Dept. of Chemistry.
SURFACE pi BONDING AND THE NEAR-FIRST-ORDER DESORPTION KINETICS OF HYDROGEN FROM Ge(100)2X1
Mark P. DEvelyn, Stephen M. Cohen, Eric Rouchouze, and Yuemei L. Yang 11 Dec. 1992 12 p
(Contract N00014-91-J-1550)
(AD-A258534; TR-11) Avail: CASI HC A03/MF A01

It is show by temperature-programmed desorption that hydrogen desorbs from Ge(100)2x1 near 570 K with near-first-order kinetics, similar to the behavior of hydrogen on Si(100)2x1. The near-first-order desorption kinetics are attributed to pairing on surface dimers induced by the pi bond on unoccupied dimer atoms, and a pairing enthalpy of 5 plus or minus 1 kcal/mol is inferred. However, a comparison between the pairing enthalpies for H atoms on Ge(100) and Si(100) with the electronic structure of the respective clean surfaces indicates that estimates of the pi bond strength

based on the surface band structure do not correlate with the propensity for pairing. GRA

N93-20052# Rice Univ., Houston, TX. Dept. of Chemistry.
INTERACTION OF HYDROGEN AND WATER WITH DIAMOND (100): INFRARED SPECTROSCOPY
Lisa M. Struck and Mark P. DEvelyn Dec. 1992 15 p
(Contract N00014-91-J-1550)
(AD-A258535; TR-13) Avail: CASI HC A03/MF A01

The first investigation of the adsorption of deuterium and water on diamond(100) by infrared multiple-internal-reflection spectroscopy using a natural type IIa diamond internal reflection element is reported. Infrared evidence was seen for the monohydride surface structure, with one hydrogen atom per surface carbon atom (delta(sub CD) mode at 901 cm(sup -1), while the dihydride (CD2) structure was not observed. Following exposure to water at elevated temperature, infrared absorption features were detected at 1280, 1200, 1125, 1080, and 720 cm(sup -1), and are assigned to ether (C-O-C), hydroxyl (C-OH), and carbonyl (-C=O) modes. The substantial observed reactivity of diamond with water indicates a potentially important role for surface hydroxyl and oxide species in the surface chemistry and morphological development of chemical vapor deposition (CVD) diamond films. GRA

N93-20054# Rice Univ., Houston, TX. Dept. of Chemistry.
PAIRING AND CLUSTERING OF HYDROGEN ON Si(100)2X1: MONTE CARLO STUDIES
Yuemei L. Yang and Mark P. DEvelyn 11 Dec. 1992 16 p
(Contract N00014-91-J-1550)
(AD-A258537; TR-12) Avail: CASI HC A03/MF A01

A generalization of the doubly-occupied dimer model proposed recently to explain the near-first-order desorption kinetics of H2 from Si(100)2x1, incorporating effective nearest-neighbor interactions between paired hydrogen atoms on adjacent dimers is considered. We have performed Monte Carlo simulations of the generalized model, and compared the pairing and cluster-size distributions with those observed recently by scanning tunneling microscopy (STM). The agreement is reasonable but the cluster size distributions differ in shape, which we suggest is due to the nonthermal nature of the distributions observed by STM and/or inadequacies in the use of nearest-neighbor interactions to represent the physics of clustering. Implications of the results for the underlying physical interactions responsible for ordering of hydrogen on Si(100) and for the desorption kinetics are discussed. GRA

N93-20237*# Sverdrup Technology, Inc., Brook Park, OH. Research Center Group.
COMPUTATION OF H2/AIR REACTING FLOWFIELDS IN DRAG-REDUCTION EXTERNAL COMBUSTION
H. T. Lai Clevland, OH Jul. 1992 18 p Presented at the 28th Joint Propulsion Conference and Exhibit, Nashville, TN, 6-8 Jul. 1992; sponsored by the AIAA, SAE, ASME, and ASEE Previously announced in IAA as A92-54115
(NASA-CR-191071; E-7624; NAS 1.26:191071; AIAA Paper 92-3672)
Avail: CASI HC A03/MF A01

Numerical simulation and analysis of the solution are presented for a laminar reacting flowfield of air and hydrogen in the case of external combustion employed to reduce base drag in hypersonic vehicles operating at transonic speeds. The flowfield consists of a transonic air stream at a Mach number of 1.26 and a sonic transverse hydrogen injection along a row of 26 orifices. Self-sustained combustion is computed over an expansion ramp downstream of the injection and a flameholder, using the recently developed RPLUS code. Measured data is available only for surface pressure distributions and is used for validation of the code in practical 3D reacting flowfields. Pressure comparison shows generally good agreements, and the main effects of combustion are also qualitatively consistent with experiment. Author (revised)

N93-20320# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
STUDY OF MULTI JET BURNER FOR GASES [ESTUDO DE QUEIMADOR MULTIPONTOS PARA GASES]
Ana Osilia Paixao Leite Jun. 1992 103 p In PORTUGESE
(INPE-5416-TDI/480) Avail: CASI HC A06/MF A02

The interaction between turbulent acetylene flames is investigated experimentally through the analysis of their visible lengths. The study involves the characterization of 1, 2, 3, and 5 flames formed by parallel and inclined jets of acetylene. The results show that the flame length of multiple jets of equal radii and equal initial velocities increases when the flame separation distance decreases and when the number of jets increases. Author

N93-20386# Rice Univ., Houston, TX. Dept. of Chemistry.
COMPETITIVE PAIRING AND THE CHEMISTRY OF COADSORBED HYDROGEN AND HALOGENS ON Ge(100)
Yuemei L. Yang, Stephen M. Cohen, and Mark P. DEvelyn 11 Dec. 1992 8 p
(Contract N00014-91-J-1550)
(AD-A258538; TR-14) Avail: CASI HC A02/MF A01

The chemistry of coadsorbed H and X (X = Cl, Br) on semiconductor surfaces is important in epitaxial growth of silicon from chlorosilanes and of Si(x)Ge(1-x) alloys, in hydrogenating/ halogenating cycles in atomic layer epitaxy, and also provides an interesting model system, yet has received little attention to date. We have investigated the interaction of HCl and HBr with Ge(100) by temperature-programmed desorption, and find that H2, HCl, and HBr each desorb with near-first-order kinetics near 570-590 K and that GeCl2 and GeBr2 desorb with near-second-order kinetics near 675 K and 710 K, respectively. Analysis of the desorption kinetics of H2 and HX leads to the conclusion that adsorbed H and X atoms pair preferentially in a qualitatively similar way as H atoms adsorbed alone on Ge(100)2x1 or Si(100)2x1 and that pairing of H+X occurs in competition with pairing of H+H. GRA

N93-20554# University of Northern Illinois, De Kalb. Dept. of Chemistry.
INTERFACIAL TENSION STUDIES OF ELECTRIFIED LIQUID/LIQUID INTERFACES: CLASSICAL TECHNIQUES FOR NEW DATA
Petr Vanysek 14 Dec. 1992 11 p
(Contract N00014-91-J-1058)
(AD-A259213; TR-045) Avail: CASI HC A03/MF A01

Several general methods used in measurement of interfacial tension are reviewed. Consideration is given to methods that can be used on interfaces with externally applied potential and current flow. A classical technique of interfacial tension measurement, the maximum bubble pressure method, is used to study an interface between two immiscible solutions of electrolytes. Data interpretation of systems under interfacial ion transfer is discussed. A series of quaternary ammonium cations at a range of concentrations spanning several orders of magnitude are investigated. It is suggested how the data can be used to determine the Esin-Markov coefficient and to estimate interfacial ion adsorption and changes of the interface due to current flow. GRA

N93-20570* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ACOUSTOPHORESIS SEPARATION METHOD Patent
Joseph S. Heyman, inventor (to NASA) 9 Mar. 1993 8 p Filed 17 Jun. 1992 Division of US-Patent-Appl-SN-628062, filed 17 Dec. 1990
(NASA-Case-LAR-13388-2; US-Patent-5,192,450;
US-Patent-Appl-SN-901627; US-Patent-Appl-SN-628062;
US-Patent-Class-210-748; US-Patent-Class-55-277;
US-Patent-Class-210-767; US-Patent-Class-210-806;
US-Patent-Class-406-197; Int-Patent-Class-B01D-17/06) Avail: US Patent and Trademark Office

A method and apparatus are provided for acoustophoresis, i.e., the separation of species via acoustic waves. An ultrasonic transducer applies an acoustic wave to one end of a sample container containing at least two species having different acoustic absorptions. The wave has a frequency tuned to or harmonized with the point of resonance of the species to be separated. This wave causes the species to be driven to an opposite end of the sample container for removal. A second ultrasonic transducer may be provided to apply a second, oppositely directed acoustic wave to prevent undesired streaming. In addition, a radio frequency tuned to the mechanical resonance and coupled with a magnetic field can serve to identify a species in a medium comprising species with similar absorption coefficients, whereby an acoustic wave having a frequency corresponding to this gyrational rate can then be applied to sweep the identified species to one

end of the container for removal.
Official Gazette of the U.S. Patent and Trademark Office

N93-20595# Harry Diamond Labs., Adelphi, MD.
ENERGY LEVELS AND PREDICTED ABSORPTION SPECTRA OF RARE-EARTH IONS IN RARE-EARTH ARSENIDES Interim Report, 1 Jul. - 30 Sep. 1992
Donald E. Wortman and Clyde A. Morrison Sep. 1992 30 p
(AD-A259136; HDL-TM-92-25) Avail: CASI HC A03/MF A01

A crystal-field Hamiltonian for octahedral symmetry was used along with free-ion parameters for aqueous solution to fit the reported optical absorption spectra of Er(3+) in ErAs. Predictions showed excellent agreement with reported experimental data at 5, 74, and 300 K. Consequently, we used an interpolation procedure to predict the crystal-field splittings of the lower multiplets of the rare-earth ions Tb(3+) through Yb(3+) in their respective arsenide compounds. The lowest multiplet energy levels predicted for Tm(3+) and Yb(3+) compare favorably with measurements made by inelastic neutron scattering. In addition, we calculate the absorption spectra for Tb(3+), Dy(3+), Ho(3+), TM(3+), and Yb(3+) in their respective arsenide compounds at 4.2, 77, and 300 K. From these calculations, we show the transitions between the levels of the lowest two J multiplets for each of the ions. GRA

N93-20756*# Alabama Univ., Huntsville. Dept. of Chemistry.
ANALYSIS OF SURFACES FROM THE LDEF A0114, PHASE 2 Semiannual Report, 1 Mar. - 31 Aug. 1992
John C. Gregory 18 Feb. 1993 19 p
(Grant NAG1-1228)
(NASA-CR-192306; NAS 1.26:192306) Avail: CASI HC A03/MF A01

During the reporting period, work continued on profilometry measurements of eroded and corroded sample surfaces, optical transmission measurements, analysis of the pinhole camera, and x-ray photoelectron spectroscopy (XPS) analysis of some samples. Among metal samples, copper showed some interesting new results. There were two forms of copper samples: a thin film sputter-coated on fused silica and a solid piece of OFHC copper. They were characterized by x-ray and Auger electron spectroscopies, x-ray diffraction, and high resolution profilometry. Cu 2p core level spectra were used to demonstrate the presence of Cu2O and CuO and to determine the oxidation states. Author (revised)

N93-20781 Department of the Navy, Washington, DC.
MATERIAL AND METHOD FOR FAST GENERATION OF HYDROGEN GAS AND STEAM Patent
Woodrow W. Lee, inventor (to Navy) 1 Sep. 1992 8 p Filed 20 Jun. 1991 Supersedes N92-15140 (30 - 6, p 905), AD-D015049
(AD-D015559; US-Patent-Appl-SN-718123; US-Patent-Class-126-263)
Avail: US Patent and Trademark Office

A high power pulse of electrical current causes a metal conductor to explode and initiate a reaction between an aluminum or aluminum alloy powder and water which generates hydrogen gas at a high temperature and pressure. The reaction mixture is released into a second larger chamber equipped with heat exchanger which extracts useful heat energy and cools down the reaction mixture. The hydrogen gas is then separated from the solid metal oxide byproducts in the cooled reaction mixture. GRA

N93-20810 Canadian Space Agency, Ottawa (Ontario). Space Station Program.
PROTECTION OF MATERIALS AND SURFACE FINISHES FROM THE LOW EARTH ORBIT SPACE ENVIRONMENT
1992 540 p Canadian Space Agency Space Station Program Forum held in Toronto, Ontario, 20-21 Feb. 1992 Prepared in cooperation with Toronto Univ., Ontario
(CTN-93-60605) Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3, HC

Results of research on environmental effects on materials in space, conducted as part of the Canadian space station program utilizing NASA's Long Duration Exposure Facility (LDEF) in low earth orbit are presented. Abstracts, papers, and illustrative material from the conference are presented. Topics covered include materials exposed to the space environment, threats from meteoroids and orbital debris, protection of composite materials in space, performance prediction of protective coatings, recommended practices for atomic oxygen exposure and analysis, development of protective coatings for space stations, the Materials Exposure in Low Earth Orbit (MELEO) experiment, low earth orbit resistant thermal control materials and dry lubricants for the Mobile Servicing System, protection of the Radarsat antenna graphite/epoxy support structure, and the use of a silicon oxide coating to protect against atomic oxygen. For individual titles, see N93-20811 through N93-20822.

N93-20811*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THE LDEF EXPERIENCE. MATERIALS
Bland A. Stein *In* Canadian Space Agency, Protection of Materials and Surface Finishes from the Low Earth Orbit Space Environment 1992 59 p (For primary document see N93-20810 07-25)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3, HC

An overview is provided of the LDEF (Long Duration Exposure Facility) mission and the preliminary findings, focusing on the materials related disciplines. These findings are based on observations of low-earth orbit environmental effects on materials made in space during LDEF retrieval and during LDEF tray deintegration, and on initial findings of laboratory analyses of LDEF materials. Included are effects of individual environmental parameters: atomic oxygen, ultraviolet radiation, meteoroid and debris impacts, thermal cycling, vacuum, and contamination, plus combined effects of these parameters. Materials considered include thermal control coatings and surface treatments, ceramics and glasses, metals, polymers, and polymer matrix composites. In general, preliminary LDEF data are remarkably consistent; LDEF will provide a benchmark for materials design data bases for satellites in low earth orbit. Some materials were identified to be encouragingly resistant to low earth orbit space environmental effects for 5.8 years; other space qualified materials displayed significant environmental degradation. Molecular contamination was widespread. Author (CISTI)

N93-20812# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
PROTECTION OF COMPOSITE MATERIALS IN SPACE. THE LDEF EXPERIENCE **c27**
R. C. Tennyson *In* Canadian Space Agency, Protection of Materials and Surface Finishes from the Low Earth Orbit Space Environment 1992 26 p (For primary document see N93-20810 07-25)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3, HC

The issues of low earth orbit space environmental effects on polymer matrix composites were investigated in the University of Toronto Institute for Aerospace Studies facility on the Long Duration Exposure Facility. Results from 5.75 years of exposure to the space environment are presented in graphic form. Particular attention is given to material erosion due to atomic oxygen, dimensional changes arising from thermal-vacuum cycling, and impact damage from micrometeoroids and debris. Design nomograms useful for estimating atomic oxygen erosion loss for different materials, micrometeoroids, and debris are also presented with examples. In addition, the role of protective coatings was examined and results are presented based on coated quartz crystal microbalance tests. Author (CISTI)

N93-20813*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ISSUES/CONSIDERATIONS AND PERFORMANCE PREDICTION OF LEO PROTECTIVE COATINGS **c27**
Bruce A. Banks *In* Canadian Space Agency, Protection of Materials and Surface Finishes from the Low Earth Orbit Space Environment 1992 83 p (For primary document see N93-20810 07-25)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3, HC

Organic materials can be used in low earth orbit for long periods only if they are made to be durable to atomic oxygen in addition to the threats of ultraviolet radiation, micrometeoroid and debris impact, thermal cycling, and charged particle radiation. In many materials applications, it is more cost-effective to utilize atomic oxygen protective coatings over materials which are vulnerable to attack by atomic oxygen rather than developing alternative materials which are inherently durable. Many metal and metal oxide coatings have been shown to be potentially suitable for long term protection of organic polymers in low earth orbit. The protection afforded by thin film coatings on polymeric substrates is highly dependent on the completeness of coverage of the coating. Thus, the prime indicator of

durability is the size and abundance of pin windows and scratches in the protective coating. Such defects depend on the deposition technique, smoothness of the surface to be protected, and presence of particulate contaminants. Issues and considerations relevant to substrate preparation, deposition of protective coatings, ground laboratory simulation and evaluation of threats in low earth orbit to protective materials, results of in-space tests, and the use of Monte Carlo modeling techniques to predict in-space durability are presented in graphic form. Author (CISTI)

N93-20814*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

RECOMMENDED PRACTICES FOR IN-SPACE AND GROUND LABORATORY. ATOMIC OXYGEN EXPOSURE AND ANALYSIS **c72**

Bruce Banks, Steve Koontz, Matt McCargo, Gary Pippin, and Sharon Rutledge *In* Canadian Space Agency, Protection of Materials and Surface Finishes from the Low Earth Orbit Space Environment 1992 27 p (For primary document see N93-20810 07-25)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3, HC

A detailed guide to testing materials for atomic oxygen durability in earth orbit environments is presented. The steps covered include sample preparation, including masking of the sample, dehydration, weighing, and handling; effective fluence prediction, including the use of witness samples (notably Kapton); plasma facility and operational considerations, involving such matters as avoidance of silicone contamination, the use of continuous versus incremental ashing, and temperature of operation; and erosion yield measurement, with calculation methods and protective coating performance indices provided. Author (CISTI)

N93-20815# Canadian Space Agency, Ottawa (Ontario). Space Station Program.

AN OVERVIEW OF SPACE QUALIFICATION REQUIREMENTS FOR NEW MATERIALS **c23**

David Madeley *In its* Protection of Materials and Surface Finishes from the Low Earth Orbit Space Environment 1992 12 p (For primary document see N93-20810 07-25)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3, HC

Space qualified materials must demonstrate they meet criteria of reproducibility, safety, and performance. The ways that these qualifications can be met are outlined along with performance parameters that are evaluated in a typical space qualification test program and possible additional tests and analyses that may be required. These performance parameters include damage sensitivity under given service conditions, thermal stability, environmental and stress corrosion resistance, thermal vacuum stability, resistance to atomic oxygen and radiation, compatibility with other materials, and mechanical properties. Author (CISTI)

N93-20816# Boeing Defense and Space Group, Seattle, WA.

SPACE STATION PROTECTIVE COATING DEVELOPMENT **c27**

Gary Pippin *In* Canadian Space Agency, Protection of Materials and Surface Finishes from the Low Earth Orbit Space Environment 1992 48 p (For primary document see N93-20810 07-25)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3, HC

A selection of candidate materials was evaluated for use in protecting space station external surfaces. Both transparent and white pigmented materials were examined for performance after exposure to atomic oxygen, solar ultraviolet, and particulate radiation. Coatings were examined post-exposure using scanning electron microscopy and x-ray photoelectron spectroscopy. Mass loss due to atomic oxygen exposure, relative to uncoated Kapton, was determined for selected coatings. Coating quality, flexibility, and tack was also evaluated. Kapton oxidation rates and materials lifetime predictions, and a general summary of the results of the examination of the candidate coatings, are presented in graphic and outline form. Author (CISTI)

N93-20817# Canadian Space Agency, Ottawa (Ontario).

MATERIALS EXPOSURE IN LOW EARTH ORBIT (MELEO) EXPERIMENT

D. G. Zimcik *In its* Protection of Materials and Surface Finishes from the Low Earth Orbit Space Environment 1992 18 p (For primary document see N93-20810 07-25)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3, HC

The MELEO experiment is part of the CANEX-2 package of experiments to be flown on STS-52, scheduled for September 1992. MELEO is an active experiment designed to measure the degradation of selected materials in the space environment, in particular the effects of atomic oxygen erosion. Active elements of the experiment are quartz crystal microbalances that are operated in a reverse mode to monitor the erosion of material from the crystal face with a high degree of accuracy. These microbalances will be attached to the end effector of the Canadarm and will record in-situ measurements of atomic oxygen flux and fluence throughout the experiment. The passive elements of the experiment are material specimens mounted in specimen holders attached to witness plates on the lower boom arm of the Canadarm. Passive fluence monitors located in the specimen holders will support the active measurement. The materials to be tested include typical spacecraft materials and new developments in protective measures against atomic oxygen. The material specimens will be exposed for at least 30 hours during the flight, will be periodically photographed to record the stages of erosion, and will be returned to earth for detailed analysis of the effects of the space environment. Author (CISTI)

N93-20818# Spar Aerospace Ltd., Brampton (Ontario).

LEO RESISTANT THERMAL CONTROL MATERIALS AND DRY LUBRICANTS FOR THE MOBILE SERVICING SYSTEM **c27**

S.-K. Chang *In* Canadian Space Agency, Protection of Materials and Surface Finishes from the Low Earth Orbit Space Environment 1992 38 p (For primary document see N93-20810 07-25)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3, HC

Nine thermal control coatings and materials together with one dry-film lubricant were tested to determine their suitability for the mobile servicing system of the Space Station Freedom. Initial screening, carried out by gravimetric measurements of erosion rates under an atomic oxygen beam, showed that all the materials (except for urethane based coatings) had sufficiently low erosion rates for potential application in the 30-year mission. Three silicate based coatings were then selected for further testing. These materials were subjected to repeated severe thermal shocks. Results showed that the adhesion of the YB-71 coating decreased with thermal shock, while the other coatings were unaffected. Two of the silicate based coatings were finally selected for testing under the combined effects of simultaneous exposure to atomic oxygen, ultraviolet radiation, and thermal cycling to simulate prolonged exposure to the low earth orbit environment. No degradation in surface morphology, thermo-optical properties or adhesion was observed. In a separate experiment, Beta-Cloth, one of the materials screened for atomic oxygen resistance, showed no significant changes to its thermo-optical properties as its Teflon coating was progressively removed in a plasma asher. Author (CISTI)

N93-20819# FRE Composites, Inc., Saint Andre-Est (Quebec).

PROTECTION OF RADARSAT SAR ANTENNA GRAPHITE/EPOXY SUPPORT STRUCTURE **c27**

E. Calius and P. Vallee *In* Canadian Space Agency, Protection of Materials and Surface Finishes from the Low Earth Orbit Space Environment 1992 21 p (For primary document see N93-20810 07-25)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3, HC

The Radarsat antenna support subsystem requirements dictated a graphite/epoxy composite material for tubular struts, to which metallic end fittings are bonded. Such materials are vulnerable to degradation in the space environment. Instead of increasing the tube wall thickness to meet end-of-life requirements, degradation was contained by isolating the composite from the environment with a protective coating. Both multilayer metallized films and anodized aluminum foil were considered for the coating. The latter was chosen because of atomic oxygen erosion concerns. Weight limitations required a very thin foil which led to production process development challenges. Among these was the bonding of the coating to the composite. Co-curing was chosen as the bonding technique since it yielded a lighter strut and was a faster process. This approach has since been modified to reduce the risks of galvanic corrosion during ground storage. Qualification testing of the foil-coated tube's mechanical and thermal

response has been completed, as well as solar absorbance, emissivity, and conductivity testing of the foil material. Author (CISTI)

N93-20820# McDonnell-Douglas Space Systems Co., Huntington Beach, CA.

PROTECTIVE COATING DEVELOPMENT FOR SPACE STATION FREEDOM AT MCDONNELL DOUGLAS **c27**

Henry W. Babel *In* Canadian Space Agency, Protection of Materials and Surface Finishes from the Low Earth Orbit Space Environment 1992 35 p (For primary document see N93-20810 07-25)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3, HC

A progress report is presented in outline and graphic form on the suitability and production readiness of both undyed and black anodic aluminum coatings for use on the Space Station Freedom. A program was undertaken to develop an understanding of how processes and aluminum alloy type and temper influenced the optical properties for chromic, sulfuric, and oxalic acid anodize. Results obtained on over 800 test points indicated that the absorptance and emissivity could be tailored for a broad range of applications. The studies included black coatings with both absorptance and emissivity greater than 0.9. The ultraviolet sensitivity of selected materials was measured for both near and far (vacuum) ultraviolet exposures. The absorptance of most alloys and tempers increased less than 0.1 in the first 1000 hours of low earth orbit sun exposure. The limited increase in absorptance from ultraviolet exposure and contamination deposition made them candidates for the space station coatings. Author (CISTI)

N93-20821# Sheldahl Co., Northfield, MN.

ATOMIC OXYGEN RESISTANT SiOx COATED KAPTON FOR SPACE STATION FREEDOM, AND ALTERNATE COATINGS **c27**

Alan Freeland, Jeffrey Fink, Gary Meinke, James Grieser, Marge Berendt, and Hiroshi Takeo (Lockheed Missiles and Space Co., Sunnyvale, CA.) *In* Canadian Space Agency, Protection of Materials and Surface Finishes from the Low Earth Orbit Space Environment 1992 19 p (For primary document see N93-20810 07-25)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3, HC

A low earth orbit (LEO), atomic oxygen resistant (AOR) thin film coating has been developed for use on the Space Station Freedom photovoltaic solar array panels. The AOR silicon oxide coating was developed in an existing sputtering system and lends itself to reasonably large production quantities. Test results of the silicon oxide coating on polyimide versus uncoated polyimide are presented, along with a discussion of the manufacturing process and associated problems and successes. The substrate used for this program was DuPont type H Kapton. The major areas of testing were environmental survivability (atomic oxygen resistance, ultraviolet and charged particle radiation stability, optical properties, and thermal shock) and physical and mechanical characterization (adhesion, blocking, flexibility, outgassing, thermal cycling, and solvent wipe and humidity resistance). Also discussed are two alternate depositions developed as potential AOR coatings, together with selected test data. Author (CISTI)

N93-20822# Ecole Polytechnique, Montreal (Quebec). Dept. of Engineering Physics.

MULTIPURPOSE PROTECTIVE COATINGS FOR SPACECRAFT APPLICATIONS **c27**

M. R. Wertheimer *In* Canadian Space Agency, Protection of Materials and Surface Finishes from the Low Earth Orbit Space Environment 1992 23 p (For primary document see N93-20810 07-25)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3, HC

Results are reported in outline and graphic form of evaluations of thin film protective layers applied to selected organic substrates (Kapton polyimide, graphite epoxy composites, and amorphous carbon) that have been shown to be attacked by atomic oxygen. These films, derived from volatile compounds via microwave glow discharge, include amorphous hydrogenated silicon, inorganic silicon compounds, and organic silicones. These materials have been exposed to attack from atomic oxygen beam bombardment, while sensitive measurements of mass loss rate and total mass loss were made in-situ using quartz crystal microbalances coated with the candidate materials. The results of mass loss measurements show that the coatings provide excellent protection compared to unprotected specimens of the same materials. Results from 20-keV electron beam bombardment show that P-SiO2 and SiN coatings on Kapton prevent discharge occurrence while other coating and substrate combinations result in discharge modification. Mechanical loading and thermal stressing have confirmed that the coatings adhere tightly to the substrate and remain intact up to the point of substrate fracture. Thermal radiative property measurements show little change from the uncoated materials in the virgin state, both before and after exposure to atomic oxygen attack. Space flight tests corroborate the laboratory results. Author (CISTI)

N93-20933# Aerospatiale, Paris (France).

NEW COMPOUNDS OBTAINED BY LPCVD IN THE B-C-N CHEMICAL SYSTEM

Frederic Saugnac (Aerospatiale Aquitaine, Saint-Medard en Jalles, France.), Francis Teyssandier (Centre National de la Recherche Scientifique, Perpignan, France.), and Andre Marchand (Centre de Recherche Paul Pascal, Pessac, France.) 1992 9 p

(Rept-921-430-111; ETN-93-91939) Avail: CASI HC A02/MF A01

The composition and some physical properties of boron carbon nitrogen B-C-N solid solutions prepared by Low Pressure Chemical Vapor Deposition (LPCVD) were investigated. Crystalline and amorphous films resulting from heterogeneous nucleation were characterized by X-ray diffraction, X-ray photoelectron spectroscopy, Rutherford back scattering and transmission electron microscopy. The compositions of these single phase materials are concentrated in two domains located in the B/N greater than 1 part of the B-C-N composition diagram. The carbon rich domain corresponds to an ideal C5B2N composition with various structural defects. The thermal stability behavior of these films is characterized by the absence of any mass loss after 1 hour at 1700 C while graphitization and formation of small amounts of B13C2 are observed. Density and electrical conductivity measurements were also performed. ESA

N93-21195# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Materials and Processes Div.

FLAMMABILITY TESTING FOR THE SCREENING OF SPACE MATERIALS

Apr. 1992 40 p

(ESA-PSS-01-721-Issue-2; ETN-93-93511) Copyright Avail: CASI HC A03/MF A01

This specification defines the test process selection criteria for the flammability testing of materials proposed for use in manned and unmanned ESA spacecraft and associated equipment. The preparatory conditions concerning hazards/safety precautions, sample preparation, facilities, and equipment, are given. The applicable test methods are included: critical oxygen index, electrical wire insulation flammability, upward propagation, configuration test method, and test for the determination of flash and fire points. Quality assurance is addressed: data/report, noncomformance, calibration, and traceability. ESA

N93-21223# Army Research Lab., Aberdeen Proving Ground, MD.

IGNITION OF NITROCELLULOSE IN VARIOUS ATMOSPHERES Final Report, Oct. 1989 - Sep. 1991

Anthony E. Finnerty, Steven A. Bowers, and Matthew O. Schroeder Nov. 1992 34 p

(AD-A257987; ARL-MR-9) Avail: CASI HC A03/MF A01

Nitrocellulose (NC) remains an important ingredient in modern gun propellants. For fire safety, the ability to extinguish burning NC, or, at least reduce its rate of combustion, would be highly desirable. Toward this end, a study has been conducted on the effect of various gases and powders on the decomposition and/or burning of NC. Chemical analyses were performed to determine the nature of the gases emitted by decomposing and burning NC. Nitric oxide (NO) was the principal nitrogen-containing product of NC decomposition in inert atmospheres when NC was heated by a nichrome ribbon. When air was present, some NO2 was also formed. The amounts of carbon monoxide (CO) and carbon dioxide (CO2) were also affected by the nature of the gaseous atmosphere. When certain nonreactive powders were mixed with the NC prior to heating with the nichrome ribbon, the combustion or decomposition of NC was greatly reduced. Maintaining power to the ribbon was necessary for combustion to continue. The formation of NO, NO2, CO, and CO2 were all affected by

the powders. When the powders were simply layered on top of NC, and the NC heated, combustion proceeded essentially as if the powders were not present. GRA

N93-21456# Michigan Univ., Ann Arbor. Gas Dynamics Labs.
DIFFUSION AND REACTION LAYER STRUCTURE AND NOx REDUCTION IN TURBULENT GAS FLAMES Annual Report, 1 Jan. - 31 Dec. 1991
James F. Driscoll and Werner J. A. Dahm 24 Aug. 1992 44 p
(Contract GRI-5087-260-1443)
(PB93-114353; GRI-92/0277) Avail: CASI HC A03/MF A01

The Annual Report describes progress made in a study aimed at identifying the fundamental mechanisms involved in NOx formation in turbulent natural gas diffusion flames and at developing novel in-flame techniques for achieving reductions in NOx emission levels in natural gas combustion applications. Temperature field images were obtained using two-dimensional Rayleigh scattering thermometry in methane-hydrogen jet diffusion flames and are being interpreted to help elucidate the basic structure of the reaction zones in flames and the relation to various species concentration fields. Highly-resolved two-dimensional conserved scalar imaging measurements from a non-reacting gaseous jet flow have been analyzed to determine the structure of numerous species concentration fields and their associated reaction rate fields in the chemical equilibrium limit. The corresponding equilibrium temperature and heat release rate fields have also been obtained for comparison with the Rayleigh thermometry measurements. These results demonstrate that while the temperature and species concentration fields may show broad zones suggestive of distributed reactions, the associated reaction rate fields indicate that the reactions in this limit are confined to relatively thin layer-like regions. Additional NOx emission index measurements have been obtained and analyzed for methane-air and hydrogen-air jet and swirl flames. These conditions have been selected to complement data obtained by other investigators at other conditions. GRA

N93-21490# Sandia National Labs., Livermore, CA.
PERTURBATIVE NEARLY-DEGENERATE FOUR-WAVE MIXING LINESHAPES IN GASES
L. A. Rahn 1992 4 p Presented at the 1st Optical Society of America (OSA) Meeting on High Resolution Spectroscopy, Salt Lake City, UT, 18-21 Jan. 1993
(Contract DE-AC04-76DP-00789)
(DE93-002673; SAND-93-8401C; CONF-930151-2) Avail: CASI HC A01/MF A01

Nearly-degenerate four-wave mixing (NDFWM) spectroscopy and the closely related tunable-laser-induced grating spectroscopies have proved to be valuable tools in the study of nonlinear optical interactions. The NDFWM spectral lineshape provides information concerning the lifetimes, and therefore the identities, of multiphoton scattering mechanisms. In addition to the great number of investigations in liquids and solids, considerable research has focused on wave-mixing in resonant atomic gases for phase conjugation applications. Although many special cases have been discussed, general expressions that include the effects of molecular motion for the NDFWM lineshape in gases have not been previously reported. The mechanisms contributing to degenerate four-wave mixing (DFWM) spectroscopy in molecular gases for application to combustion and chemical physics research are addressed. Expressions for the NDFWM lineshape were developed for nearly forward- and counter-propagating collinear pump-beam geometries. The lineshapes were derived by applying the velocity integration methods used by Lam and Abrams for the phase-conjugate DFWM to the perturbation-theory expressions developed by Tretout, et al. for resonance coherent anti-Stokes Raman spectroscopy. The resultant expressions thus include the effects of molecular degeneracy on the polarization characteristics of chi(sup 3). DOE

N93-21555*# Indiana Univ., Bloomington. Dept. of Chemistry.
FREE RADICAL AND OVERTONE SPECTROSCOPY Final Report
James P. Reilly 30 Jul. 1991 10 p
(Grant NAGw-1670)
(NASA-CR-192136; NAS 1.26:192136) Avail: CASI HC A02/MF A01

In the fall of 1987 during a photoacoustic study of hydrogen peroxide's fourth vibrational overtone band, the remarkably clear and well resolved spectrum was observed. Its periodicity and K subband structure suggested that the spectrum was not of hydrogen peroxide but of a smaller near-prolate symmetric top molecule. Furthermore, the time dependent behavior of the signal indicated that chemical changes were taking place within the photoacoustic apparatus. Author

N93-21564*# Arizona Univ., Tucson. NASA Space Engineering Research Center.
NASA SPACE ENGINEERING RESEARCH CENTER FOR UTILIZATION OF LOCAL PLANETARY RESOURCES Annual Progress Report, 1990-1991
Kumar Ramohalli and John S. Lewis 1991 365 p
(Grant NAGw-1332)
(NASA-CR-191989; NAS 1.26:191989; APR-91/F) Avail: CASI HC A16/MF A03

Because of a change in the NASA funding cycle, the present reporting period covers only the six months from March to September 1991. Nevertheless, remarkable progress was made in a number of areas, some of the most noteworthy of which are: (1) Engineering operation of a breadboard CO2 yields O2 demonstration plant that produced over 10 grams of oxygen per day during several runs of over 100 hours each with a single electrolytic cell. Complete automation of controls, monitoring of various inputs/outputs and critical internal variables, diagnostics, and emergency shutdown in an orderly manner were also included. Moreover, 4-cell and 16-cell units, capable of much higher rates of production, were assembled and tested. (2) Demonstration of a 200 percent increase in the carbothermal reduction of ilmenite through vapor deposition of carbon layers on particles of that material. (3) Demonstration of the deposition of strong iron films from carbonyl chemical vapor deposition, establishing the crucial role of additive gases in governing the process. (4) Discovery of an apparent 800 percent increase in the conversion rates of a modified ilmenite simulant in a plasma-augmented reactor, including direct enhancement by solar radiation absorption. (5) Proof that test specimens of lunar soil with small amounts of metallic additives, recrystallized at moderate temperatures, exhibit an improvement of several orders of magnitude in ductility/tensile strength. (6) Experiments establishing the feasibility of producing silicon-based polymers from indigenous lunar materials. (7) Application of CCD technology to the production of maps of TiO2 abundance, defining primary ilmenite deposits, on the disk of the full moon. (8) Attainment of a discovery rate of approximately 3 new near-Earth asteroids per month by Spacewatch, more than doubling the previous global rate. (9) Coordination of industry and university magma electrolysis investigations in a workshop designed to define remaining problem areas and propose critical experiments.
Author (revised)

N93-21651# Cornell Univ., Ithaca, NY. School of Chemical Engineering.
MOLECULAR THEORY AND COMPUTER SIMULATION STUDIES OF NATURAL AND SYNTHETIC GAS MIXTURES Annual Report, Jan. - Dec. 1990
K. E. Gubbins 31 Jan. 1991 61 p
(Contract GRI-5087-260-1452)
(PB92-235696; GRI-92/0252) Avail: CASI HC A04/MF A01

The effect of molecular associations on the phase equilibria of fluids with multiple bonding sites is investigated. The individual molecules are represented by a chain of fused spheres with off-center, square-well attractive sites. Such a system's thermodynamic properties can be calculated by using expressions based on a cluster expansion theory. Comparisons with experimental data has been made for several pure fluids of associating molecules, including acetone, methanol, ethanol, and nitric oxide. The results are excellent. Such comparisons have also been made for alkane-alcohol mixtures. Results for phase equilibria, heats of mixing, and heat capacities show quite good agreement for the shorter chain molecules (up to C6 or C8) but become poorer for longer chain lengths. Molecular dynamics simulations have been carried out to study the kinetics of H-bond formation and breaking for alcohols. The work is continuing. GRA

N93-21653# Rice Univ., Houston, TX. Dept. of Chemical Engineering.
P-V-T SURFACE STUDIES FOR NORMAL FLUID-HYDROGEN BONDING FLUID MIXTURES Final Report, 1 Jan. - 30 Dec. 1990
Riki Kobayashi, Andrew Ward, Maurice D. Jett, David Morgan, and Fouad Fleyfel 15 Jun. 1992 119 p Sponsored by Gas Research Institute
(Contract GRI-5087-260-1496)
(PB93-102242; GRI-92/0236) Avail: CASI HC A06/MF A02

The Pressure-Volume-Temperature (P-V-T) surfaces for pure components and binary mixtures have been examined experimentally using the Burnett-Isochoric P-V-T methods over a period of years. The data have been fitted along each isochore and over the entire surface. The equation of state for the surfaces were fitted by a modified version of the equation of state developed by Harr. Double differentiation along each isochore was performed to see if an inflection point along the isochore existed. The nature of the P-V-T surface could be succinctly gathered for both the pure components and the mixtures by examining whether the isochores were open or closed. Normal fluids and normal fluid mixtures gave closed isochores (with respect to the inflection locus and the vapor pressure curve). On the other hand, quantum fluids and their mixtures, and hydrogen bonding fluids and their mixtures showed open isochoric inflection loci owing to the effect of temperature on the effective molecular sizes of the quantum fluid and the hydrogen bonding fluids. The resulting observations dictate the form of the equation of state and/or the limitations of the existing corresponding states correlations and the equations of state presently being used to represent P-V-T surfaces. GRA

N93-21749*# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.

A k-OMEGA-MULTIVARIATE BETA PDF FOR SUPERSONIC COMBUSTION

G. A. Alexopoulos, R. A. Baurle, and H. A. Hassan 1992 8 p

(Grants NAG1-244; NAGw-1331)

(NASA-CR-191930; NAS 1.26:191930) Avail: CASI HC A02/MF A01

In an attempt to study the interaction between combustion and turbulence in supersonic flows, an assumed PDF has been employed. This makes it possible to calculate the time average of the chemical source terms that appear in the species conservation equations. In order to determine the averages indicated in an equation, two transport equations, one for the temperature (enthalpy) variance and one for Q, are required. Model equations are formulated for such quantities. The turbulent time scale controls the evolution. An algebraic model similar to that used by Eklund et al was used in an attempt to predict the recent measurements of Cheng et al. Predictions were satisfactory before ignition but were less satisfactory after ignition. One of the reasons for this behavior is the inadequacy of the algebraic turbulence model employed. Because of this, the objective of this work is to develop a k-omega model to remedy the situation. Author

N93-21767# IIT Research Inst., Bartlesville, OK. National Inst. for Petroleum and Energy Research.

THERMODYNAMIC MODELING FOR ORGANIC SOLID PRECIPITATION

T. H. Chung Dec. 1992 29 p

(Contract DE-FC22-83FE-60149)

(DE93-000104; NIPER-623) Avail: CASI HC A03/MF A01

A generalized predictive model which is based on thermodynamic principle for solid-liquid phase equilibrium has been developed for organic solid precipitation. The model takes into account the effects of temperature, composition, and activity coefficient on the solubility of wax and asphaltenes in organic solutions. The solid-liquid equilibrium K-value is expressed as a function of the heat of melting, melting point temperature, solubility parameter, and the molar volume of each component in the solution. All these parameters have been correlated with molecular weight. Thus, the model can be applied to crude oil systems. The model has been tested with experimental data for wax formation and asphaltene precipitation. The predicted wax appearance temperature is very close to the measured temperature. The model not only can match the measured asphaltene solubility data but also can be used to predict the solubility of asphaltene in organic solvents or crude oils. The model assumes that asphaltenes are dissolved in oil in a true liquid state, not in colloidal suspension, and the precipitation-dissolution process is reversible by changing thermodynamic conditions. The model is thermodynamically consistent and has no ambiguous assumptions. DOE

N93-21803# SRI International Corp., Menlo Park, CA.

CHEMICAL AND CATALYTIC ACTIVATION OF METHANE BY METAL OXIDE SURFACES Annual Report, Sep. 1989 - Aug. 1990

Jon G. McCarty and Eric D. Wachsman Jun. 1992 69 p Sponsored by Gas Research Institute, Chicago, IL

(Contract GRI-5086-260-1328)

(PB93-121994; GRI-92/0263) Avail: CASI HC A04/MF A01

The objectives of the research are to investigate the nature of surface oxygen centers capable of selective conversion of methane into hydrocarbon fuels through catalytic selective oxidation and to determine the role of homogeneous reactions in the catalytic coupling process. Major accomplishments of the current work include the development of stable redox coupling catalysts and the identification of impurity metals in alkaline earth catalysts. The authors explored the ability of lanthana-based iron and manganese perovskites to serve as selective redox catalysts. The authors's results indicate that protective alkali or alkaline earth layers are necessary for these transition metal perovskites to have acceptable higher hydrocarbon selectivity. Oxygen transfer clearly did not limit the reactivity of these catalyst/reactants under coupling conditions. Sensitive surface analysis of calcined CaO and MgO alkaline earth and zirconia co-oxidative methane dimerization catalysts by laser ionization (SALI) showed unexpectedly high levels (to approx 1000 ppm) of segregated base metals, especially iron. Catalysts with higher iron levels had poorer higher hydrocarbon selectivity and higher carbon dioxide to carbon monoxide product ratios. The authors conclude that the impurity segregated metal cations, by attracting excess reducible oxygen to the surfaces, cause the poorer performance of CaO and MgO relative to alkali oxide catalysts. Dissert. Abstr.

N93-21813# Pennsylvania Univ., Philadelphia. Dept. of Chemistry.

METALLORADICAL AND ELECTROPHILIC ACTIVATION OF METHANE Annual Report, Aug. 1991 - Jul. 1992

Bradford B. Wayland 31 Aug. 1992 14 p Sponsored by Gas Research Inst., Chicago, IL

(Contract GRI-5091-260-2183)

(PB93-123693; GRI-92/0383) Avail: CASI HC A03/MF A01

The primary objectives for the project are to identify metal species capable of reacting with the C-H bond of methane to functionalized alkyl derivatives. Thermodynamic studies of transition metal hydride and organometallic derivatives resulted in recognizing that rhodium (2) porphyrins would have favorable thermodynamics for methane C-H bond reactions. Mechanistic considerations suggested that a low energy pathway for cleaving the strong C-H bond could result from concerted formation of metal hydride and alkyl bonds. Metal complexes containing rhodium and iridium were shown to react with the C-H bond in methane to form metal hydride and alkyl species. Thermodynamic feasibility for these reactions results from the formation of relatively strong metal-methyl bonds. The kinetic pathway involves the simultaneous reaction of two metal complexes with methane and the steric requirements of the reactants provide an opportunity to attain reaction selectivity. The small size of methane and steric restrictions of the transition state are responsible for CH4 reacting faster than any other alkane or aromatic hydrocarbons studied. Information from these studies is being utilized as a guide in designing new metal complexes with improved reaction rates and selectivity. GRA

N93-21824# Ecole Centrale de Lyon (France).

STUDY ON PHOTOCHEMICAL AND PHOTOELECTROCHEMICAL ETCHING OF GALLIUM ARSENIDE Ph.D. Thesis [ETUDE DE LA GRAVURE PHOTOCHIMIQUE ET PHOTO-ELECTROCHIMIQUE DE L'ARSENUIRE DE GALLIUM]

Michel Achard (Institut National des Sciences Appliquees, Lyon, France.) 1991 162 p In FRENCH

(ECL-91-25; ETN-93-91954) Avail: CASI HC A08/MF A02

A study on photochemical and photoelectrochemical etching aimed at developing machining of gallium arsenide substrates is presented. By varying different parameters (pH and solution composition, wavelength of the incidence light, and sample structure), it is shown that only photoelectrochemical etching can be used for the object application. Also, for a binary semiconductor, the influence of the surface chemistry and the crystallographic orientation on the attack selectivity is shown. A comparative study of photoelectrochemical etching of N type GaAs in acid, acid-oxygenated water, and acid-hypochlorite mediums is given. Photoelectrochemical etching of semi insulated GaAs is studied. ESA

N93-21825# Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.

FUNDAMENTAL ADVANCES FOR CHARACTERIZING CATHODIC PROTECTION SYSTEMS Annual Report, Aug. 1991 - Jul. 1992

R. Srinivasan and J. C. Murphy Aug. 1992 93 p Sponsored by Gas

Research Inst., Chicago, IL
(Contract GRI-5091-260-2118)
(PB93-125003; GRI-92/0360) Avail: CASI HC A05/MF A01

Cathodic polarization (CP) is the common method for protection of gas pipelines from corrosion. Pipe-to-soil potential measurements have been conventionally used to monitor the level of corrosion protection. However, there are continuing incidents of corrosion related failures of nominally protected lines even for those which had routinely met the -0.85 V standard. An alternative method for monitoring the effectiveness of CP systems is measurement of local corrosion rates under CP. The method the authors are investigating is based on faradaic rectification. It exploits the non-linear current responses of a metal/electrolyte interface to an applied voltage. During the 1991-92 period, it was applied to measurements of steel corroding in sodium sulfate and sulfuric acid. Some of these results were verified by weight loss measurements. The corrosion rates for steel in sulfuric acid was found to be higher than in sodium sulfate, independent of the level of cathodic polarization. The measured metal dissolution rates found using faradaic rectification were in order of magnitude agreement with weight loss experiments. The main goal for 1993 is to test the improved instrumentation under conditions which are representative of the field environment, and the rate will be measured under various concentrations of chloride and carbonate ions. In addition, they hope to extend the theory of faradaic rectification to cover partial mass transfer control. GRA

N93-21835# Lehigh Univ., Bethlehem, PA.
MECHANISMS AND CONTROLLING CHARACTERISTICS OF THE CATALYTIC OXIDATION OF METHANE
K. Klier, G. W. Simmons, R. G. Herman, and A. C. Miller 1992 13 p
(Contract DE-FG02-86ER-13580)
(DE93-005719; DOE/ER-13580/T2) Avail: CASI HC A03/MF A01

Methane is readily activated at mild conditions (100 C, 1 torr) over a relatively noble metal, Pd. This was observed using a stepped and kinked Pd(679) crystal(1), and other crystal faces are now being investigated to establish whether the cracking of the C-H bond of methane on Pd is structure sensitive or structure insensitive. Oxygen chemisorption is extremely structure sensitive: weakly bonded, highly reactive oxygen overlayers form on Pd(100) surface(2), while strongly bonded, moderately reactive oxygen overlayers form on Pd(111) and Pd(679). Reaction of the weakly bonded oxygen with surface carbide gives rise to CO2 over clean Pd(100) but to CO over halogen-doped Pd(100) (3-5). The effect of halogens is primarily ensemble-controlling, or oxygen-supply restricting, but long range influence of surface Cl on the strength of the Pd-O bond was also observed. Because the overall chemistry of methane activation with the subsequent oxidation gives rise to the very important oxidative reforming CH4 + 1/2O2 yields(sub Pd/Cl) CO + 2H2, we plan to continue our study of this reaction in detail over Pd(100) (completed), Pd(111) (initiated), Pd(311) (initiated), Pd(110) (to be initiated), and Pd(679) (completed), without and with the halogen modifiers. DOE

N93-21836# Syracuse Univ., NY. Dept. of Chemical Engineering and Materials Science.
MECHANISMS OF GAS PERMEATION THROUGH POLYMER MEMBRANES
S. A. Stern 1992 36 p
(Contract DE-FG02-87ER-13649)
(DE93-005960; DOE/ER-13649/T2) Avail: CASI HC A03/MF A01

Progress is reported in two areas. Concentration-temperature superposition principle (CTSP) is studied. CTSP is a theoretical model for describing the gas solubility in glassy polymers swollen by the penetrant gas. It has been extended to describe the dependence of gas diffusivity and permeability on penetrant pressure. Further extension to diffusion of gas mixtures is being studied. Solubility of gases in poly(alkyl methacrylates) is studied. Solubility of methane in poly(ethyl methacrylate) and poly(n-butyl methacrylate) was measured; the Langmuir capacity constant was found to not reflect a lower excess free volume; an equation is given for relating the constant to the glass transition temperature. Solubility of ethane in the latter polymer is affected by plasticization. DOE

N93-21840# Sandia National Labs., Livermore, CA.
INVERSE RAMAN SPECTROSCOPY MEASUREMENTS OF LINE-SHIFT COEFFICIENTS IN HYDROGEN PERTURBED BY ARGON
J. W. Forsman, R. L. Farrow, and L. A. Rahn 1993 3 p Presented at the First Optical Society of America Meeting on High Resolution Spectroscopy, Salt Lake City, UT, 18-21 Jan. 1993
(Contract DE-AC04-76DR-00789)
(DE93-003906; SAND-93-8402C; CONF-930151-3) Avail: CASI HC A01/MF A01

High resolution Raman studies of the Q branch in H2 perturbed by Ar are relevant to combustion diagnostics and for tests of the intermolecular potential. The use of spectroscopic techniques to study combustion requires accurate models for the line shapes which can range from Lorentzian to Gaussian to more complicated profiles depending on the perturber species, perturber concentration, density, and temperature. Calculations with these models require estimates of the speed dependence of the line-shift and line-broadening coefficients. Modern theories are now able to predict the shifting and broadening resulting from collisions but are hampered by uncertainties in the interaction potential. One of the most studied potentials is that of H2-Ar which has the advantage of being theoretically tractable for line shape computations. Furthermore, since the masses of Ar and molecular O2 and N2 are similar, spectral features depending on the perturber's mass are expected to be similar. Preliminary measurements of the density shift of the Q branch lines in H2 as a function of rotational state and temperature are reported. DOE

N93-21976# California Univ., Berkeley. Lawrence Berkeley Lab.
LEWIS NUMBER EFFECTS ON TURBULENT PREMIXED FLAME STRUCTURE
P. J. Goix (Centre National de la Recherche Scientifique, Mont-Saint-Aignan, France.) and I. G. Shepherd Sep. 1992 23 p Presented at the 1992 Combustion Institute Fall Meeting of the Western States Section, Berkeley, CA, 12-13 Oct. 1992
(Contract DE-AC03-76SF-00098)
(DE93-002571; LBL-32926; CONF-9210213-3) Avail: CASI HC A03/MF A01

The influence of the Lewis number on turbulent flame front geometry is investigated in a premixed turbulent stagnation point flame. A laser tomography technique is used to obtain the flame shape, a fractal analysis of the multiscale flame edges is performed, and the distribution of local flame front curvature is determined. Lean H2/air and C3H8/air mixtures with similar burning rates were investigated with Lewis numbers of 0.33 and 1.85, respectively. At the conditions studied, the laminar H2/air mixture is unstable and a cellular structure is observed. Turbulence in the reactant is generated by a perforated plate and the turbulent length scale (3 mm) and intensity (7 percent) at the nozzle exit are fixed. The equivalence ratio is set so that the burning velocity is the same for all the cases. Results show clearly that the turbulent flame surface area is dependent on the Lewis number. For a Lewis number less than unity, surface area production is observed. The shape of the flame front curvature distribution is not found to be very sensitive to the Lewis number. For the H2/air mixture the distribution is skewed toward the positive values indicating the presence of cusps while for the C3H8/air mixture the distribution is more symmetrical. In both cases, the average curvature is found to be zero, and if the local burning speed varies linearly with curvature, the local positive and negative burning velocity variations due to curvature will balance. DOE

N93-22006*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
ANALYSIS OF IMPACTOR RESIDUES IN TRAY CLAMPS FROM THE LONG DURATION EXPOSURE FACILITY. PART 1: CLAMPS FROM BAY A OF THE SATELLITE
Michael E. Zolensky and Ronald P. Bernhard (Lockheed Engineering and Sciences Co., Houston, TX.) Mar. 1993 201 p
(NASA-TM-104759; S-708; NAS 1.15:104759) Avail: CASI HC A10/MF A03

The Long Duration Exposure Facility (LDEF) was placed in low Earth orbit (LEO) in 1984 and was recovered 5.7 years later. The LDEF was host to several individual experiments that were specifically designed to characterize critical aspects of meteoroid and debris environment in LEO. It was realized from the beginning, however, that the most efficient use of the satellite would be to examine the entire surface of the Earth for impact features. In this regard, particular interest has centered on common exposed materials that faced in all LDEF pointing directions. Among the most important of these materials is the tray clamps. Therefore, in an effort to understand the nature of particulates in LEO and their effects on

spacecraft hardware better, we are analyzing residues found in impact features on LDEF tray clamp surfaces. This catalog presents all data from clamps from Bay A of the LDEF. Subsequent catalogs will include clamps from succeeding bays of the satellite. Author

N93-20187*# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemical Engineering.
FULLERENES FORMATION IN FLAMES
Jack B. Howard *In* NASA, Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 73-79 (For primary document see N93-20178 07-29)
(Contract DE-FG02-84ER-13282; NIEHS-5-P30-ES02109-10; NIEHS-5-P01-ES01640-11)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20189*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
EFFECTS OF BUOYANCY ON LAMINAR, TRANSITIONAL, AND TURBULENT GAS JET DIFFUSION FLAMES
M. Yousef Bahadori (Science Applications International Corp., Torrance, CA.), Dennis P. Stocker, David F. Vaughan (Baldwin-Wallace Coll., Berea, OH.), Liming Zhou (California Univ., Berkeley.), and Raymond B. Edelman (Rockwell International Corp., Canoga Park, CA.) *In its* The Second International Microgravity Combustion Workshop Feb. 1993 p 91-105 (For primary document see N93-20178 07-29)
(Contracts NAS3-22822; NAS3-25982)
Avail: CASI HC A03/MF A03; 11 functional color pages

N93-20190*# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
STRUCTURE AND SOOT PROPERTIES OF NON-BUOYANT LAMINAR ROUND-JET DIFFUSION FLAMES
Saeed Mortazavi, Peter B. Sunderland, Jongsoo Jurng, and Gerard M. Faeth *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 107-113 (For primary document see N93-20178 07-29)
(Grant NAG3-1245)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20191*# Michigan State Univ., East Lansing. Dept. of Mechanical Engineering.
AN EXPERIMENTAL AND THEORETICAL STUDY OF RADIATIVE EXTINCTION OF DIFFUSION FLAMES
Arvind Atreya, Indrek Wichman, Mark Guenther, Anjan Ray, and Sanjay Agrawal *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 115-120 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20192*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SOOT FORMATION AND RADIATION IN TURBULENT JET DIFFUSION FLAMES UNDER NORMAL AND REDUCED GRAVITY CONDITIONS
Jerry C. Ku (Wayne State Univ., Detroit, MI.), Li Tong (Wayne State Univ., Detroit, MI.), Jun Sun (Wayne State Univ., Detroit, MI.), Paul S. Greenberg, and DeVon W. Griffin (Sverdrup Technology, Inc., Brook Park, OH.) *In its* The Second International Microgravity Combustion Workshop Feb. 1993 p 121-133 (For primary document see N93-20178 07-29)
Avail: CASI HC A03/MF A03; 11 functional color pages

N93-20193*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
VISUALIZATION AND IMAGING METHODS FOR FLAMES IN MICROGRAVITY
Karen J. Weiland *In its* The Second International Microgravity Combustion Workshop Feb. 1993 p 135-140 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20194*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SELECTED MICROGRAVITY COMBUSTION DIAGNOSTIC TECHNIQUES
DeVon W. Griffin (Sverdrup Technology, Inc., Brook Park, OH.) and Paul S. Greenberg *In its* The Second International Microgravity Combustion Workshop Feb. 1993 p 141-147 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20195*# United Technologies Research Center, East Hartford, CT.
LASER DIAGNOSTICS FOR MICROGRAVITY DROPLET STUDIES
Michael Winter *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 149-155 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20196*# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.
STUDIES OF PREMIXED LAMINAR AND TURBULENT FLAMES AT MICROGRAVITY
Paul D. Ronney *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 159-164 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20197*# Illinois Univ., Urbana. Dept. of Aeronautic and Astronautic Engineering.
MODELING OF MICROGRAVITY COMBUSTION EXPERIMENTS
John Buckmaster *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 165-170 Sponsored in part by AFOSR (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20198*# Naval Research Lab., Washington, DC. Lab. for Computational Physics and Fluid Dynamics.
STRUCTURE AND DYNAMICS OF PREMIXED FLAMES IN MICROGRAVITY
K. Kailasanath and Gopal Patnaik (Berkeley Research Association, Springfield, VA.) *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 171-176 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20199*# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.
ON THE STRUCTURE AND STABILIZATION MECHANISMS OF PLANAR AND CYLINDRICAL PREMIXED FLAMES
James A. Eng, Delin Zhu, and Chung K. Law *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 177-182 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20200*# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
THE EFFECTS OF GRAVITY ON WRINKLED LAMINAR FLAMES
Larry W. Kostiuk, Liming Zhou, and Robert K. Cheng *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 183-188 (For primary document see N93-20178 07-29)
(NASA Order C-32000-R)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20201*# McGill Univ., Montreal (Quebec). Dept. of Mechanical Engineering.
MICROGRAVITY COMBUSTION OF DUST SUSPENSIONS
John H. S. Lee, Olivier Peraldi, and Rom Knystautas *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 189-195 Sponsored in part by Canadian Space Agency (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20202*# California Univ., San Diego, La Jolla. Dept. of Applied Mechanics and Engineering Sciences.
THE STRUCTURE OF PARTICLE CLOUD PREMIXED FLAMES

K. Seshadri *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 197-202 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20203*# Colorado School of Mines, Golden. Dept. of Metallurgical and Materials Engineering.
COMBUSTION SYNTHESIS OF CERAMIC AND METAL-MATRIX COMPOSITES
John J. Moore, Heng J. Feng, Kevin J. Hunter, and David G. Wirth (Coors Porcelain Co., Golden, CO.) *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 203-209 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20205*# National Inst. of Standards and Technology, Gaithersburg, MD. Building and Fire Research Lab.
IGNITION AND SUBSEQUENT FLAME SPREAD OVER A THIN CELLULOSIC MATERIAL
Kazuyoshi Nakabe (Osaka Univ., Japan.), Howard R. Baum, and Takashi Kashiwagi *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 229-236 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20206*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
OPPOSED-FLOW FLAME SPREADING IN REDUCED GRAVITY
Robert A. Altenkirch (Mississippi State Univ., Mississippi State.), Subrata Bhattacharjee (San Diego State Univ., CA.), Sandra L. Olson, and Kurt R. Sacksteder *In its* The Second International Microgravity Combustion Workshop Feb. 1993 p 237-243 (For primary document see N93-20178 07-29)
(Contracts NAS3-23901; NCC3-221)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20207*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COMBUSTION OF SOLID FUEL IN VERY LOW SPEED OXYGEN STREAMS
James S. Tien (Case Western Reserve Univ., Cleveland, OH.), Kurt R. Sacksteder, Paul V. Ferkul (Case Western Reserve Univ., Cleveland, OH.), and Gary D. Grayson (Case Western Reserve Univ., Cleveland, OH.) *In its* The Second International Microgravity Combustion Workshop Feb. 1993 p 245-250 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20208*# California Univ., Berkeley. Dept. of Mechanical Engineering.
A FUNDAMENTAL STUDY OF SMOLDERING COMBUSTION IN MICROGRAVITY
Carlos Fernandez-Pello and Patrick J. Pagni *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 251-256 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20209*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
FLAME SPREAD ACROSS LIQUID POOLS
Howard Ross, Fletcher Miller (Case Western Reserve Univ., Cleveland, OH.), David Schiller (California Univ., Irvine.), and William A. Sirignano (California Univ., Irvine.) *In its* The Second International Microgravity Combustion Workshop Feb. 1993 p 257-264 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20210*# Colorado Univ., Boulder. Dept. of Mechanical Engineering.
A STUDY OF IGNITION PHENOMENA OF BULK METALS BY RADIANT HEATING
Melvin C. Branch, A. Abbud-Madrid, T. J. Feiereisen, and J. W. Daily *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 265-271 (For primary document see N93-20178 07-29)
(Grant NAG3-1257)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20211*# National Aeronautics and Space Administration. White Sands Test Facility, NM.
METALS COMBUSTION IN NORMAL GRAVITY AND MICROGRAVITY
Theodore A. Steinberg (Lockheed Electronics Co., White Sands Missile Range, NM.), D. Bruce Wilson (Lockheed Electronics Co., White Sands Missile Range, NM.), and Frank J. Benz *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 273-279 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20212*# California Univ., San Diego, La Jolla. Dept. of Applied Mechanics and Engineering Sciences.
STUDIES OF DROPLET BURNING AND EXTINCTION
Forman A. Williams *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 283-290 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20213*# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.
COMPUTATIONAL/EXPERIMENTAL STUDIES OF ISOLATED, SINGLE COMPONENT DROPLET COMBUSTION
Frederick L. Dryer *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 291-296 (For primary document see N93-20178 07-29)
(Contract NAS3-1231)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20214*# California Univ., Davis. Dept. of Mechanical, Aeronautical and Materials Engineering.
COMBUSTION EXPERIMENTS IN REDUCED GRAVITY WITH TWO-COMPONENT MISCIBLE DROPLETS
Benjamin D. Shaw and Israel Aharon *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 297-302 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20215*# Centre National de la Recherche Scientifique, Orleans (France). Lab. de Combustion et Systemes Reactifs.
STATUS OF THE CNRS-LCSR PROGRAM ON HIGH PRESSURE DROPLET VAPORIZATION AND BURNING
Christian Chauveau and Iskender Goekalp *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 303-309 Sponsored in part by ESA; CNES; SEP; Commission of the European Communities; European Car Manufacturers; French Army Research Office; and ONERA Original contains color illustrations (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20216*# Tokyo Univ. (Japan). Dept. of Aeronautics.
HIGH-PRESSURE DROPLET COMBUSTION STUDIES
Masato Mikami, M. Kono, Junichi Sato (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo, Japan.), Daniel L. Dietrich (Sverdrup Technology, Inc., Cleveland, OH.), and Forman A. Williams (California Univ., San Diego, La Jolla.) *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 311-316 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20217*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COMBUSTION OF INTERACTING DROPLET ARRAYS IN A MICROGRAVITY ENVIRONMENT
Daniel L. Dietrich (Sverdrup Technology, Inc., Cleveland, OH.) and John B. Haggard *In its* The Second International Microgravity Combustion Workshop Feb. 1993 p 317-323 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20218*# Yale Univ., New Haven, CT. Dept. of Mechanical Engineering.
THE ELECTROSPRAY: FUNDAMENTALS AND COMBUSTION APPLICATIONS
Alessandro Gomez *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 325-330 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20219*# Cornell Univ., Ithaca, NY. School of Mechanical and Aerospace Engineering.
CHARACTERIZING DROPLET COMBUSTION OF PURE AND MULTI-COMPONENT LIQUID FUELS IN A MICROGRAVITY ENVIRONMENT
Gregory S. Jackson and C. Thomas Avedisian *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 331-337 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

N93-21094# McGill Univ., Montreal (Quebec). Dept. of Mechanical Engineering.
MICROGRAVITY COMBUSTION OF DUST CLOUDS
J. H. S. Lee and R. Knystautas *In* Canadian Space Agency, Spacebound 1991 1991 p 118-122 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21913# Fisk Univ., Nashville, TN. Dept. of Physics.
FOURIER-TRANSFORM INFRARED SPECTROSCOPY APPLIED TO EXPLOSIVE VAPOR DETECTION
Don O. Henderson, Enrique Silberman, and F. W. Snyder (Federal Aviation Administration, Atlantic City, NJ.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 604-617 (For primary document see N93-21856 07-03)
(Contract DTFA01-87-C-00042)
Avail: CASI HC A03/MF A10

N93-21917# Oak Ridge National Lab., TN. Analytical Chemistry Div.
TANDEM MASS SPECTROMETRY FOR EXPLOSIVES VAPOR DETECTION
Gary L. Glish, S. A. McLuckey, B. C. Grant, and H. S. McKown *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 642-652 (For primary document see N93-21856 07-03)
(Contract DE-AC05-84OR-21400)
Avail: CASI HC A03/MF A10

N93-21918# SCIEX, Thornhill (Ontario).
MODIFICATIONS TO THE IONIZATION PROCESS TO ENHANCE THE DETECTION OF EXPLOSIVES BY API/MS/MS
William R. Davidson, Bruce A. Thomson, Takeo Sakuma, William R. Stott, Alan Keith Akery (British Aerospace Security Systems, Bristol, England.), and Richard Sleeman (British Aerospace Security Systems, Bristol, England.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 653-662 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

N93-21919# SCIEX, Thornhill (Ontario).
THE ROLE OF MASS SPECTROMETRY IN THE DETECTION OF EXPLOSIVES
William R. Davidson, William R. Stott, Alan Keith Akery (British Aerospace Security Systems, Bristol, England.), and Richard Sleeman (British Aerospace Security Systems, Bristol, England.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 663-671 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

N93-21920# Barringer Research Ltd., Rexdale (Ontario).
MODIFICATION TO THE IONIZATION PROCESS TO ENHANCE THE DETECTION OF EXPLOSIVES BY IMS
Lucy L. Danylewych-May *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 672-686 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

N93-21922# Federal Bureau of Investigation Academy, Quantico, VA. Forensic Science Research Unit.
DETECTION OF TRACE EXPLOSIVE EVIDENCE BY ION MOBILTY SPECTROMETRY
Dean D. Fetterolf and Tracy D. Clark (Southwest Missouri State Univ., Springfield.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 689-702 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

N93-21923# Thermedics, Inc., Woburn, MA.
ANALYSIS OF EXPLOSIVES USING HIGH SPEED GAS CHROMATOGRAPHY WITH CHEMILUMINESCENT DETECTION
David P. Rounbehler, Stephen J. MacDonald, David P. Lieb, and David H. Fine *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 703-713 Sponsored in cooperation with the State Dept. (For primary document see N93-21856 07-03)
(Contract DTRS-57-84-C)
Avail: CASI HC A03/MF A10

N93-21937# Science Applications International Corp., Santa Clara, CA.
FAST NUCLEAR SPECTROSCOPY FOR EXPLOSIVE DETECTION SYSTEMS
Peter Ryge, R. Benetti, A. Patel, and E. Chou *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 825-839 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N93-19963# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
VIBRATIONAL SPECTROSCOPIC STUDIES OF ADSORBATES ON BIMETALLIC SURFACES Ph.D. Thesis
William K. Kuhn Dec. 1992 162 p
(AD-A258578; AFIT/CI/CIA-92-028D) Avail: CASI HC A08/MF A02

In this work, well-defined bimetallic surfaces have been studied using carbon monoxide adsorption in conjunction with infrared reflection absorption spectroscopy (IRAS). These studies have indicated that for CO adsorbed on Cu overlayers, the bond between the CO and the Cu adatoms is comprised of both pi-back-donation and polarization interaction components. The sum of the contributions from these effects determines the observed bond strength with the observed CO stretching frequency being determined by the relative contributions of the components. In addition, it was determined that IR spectra of adsorbed CO show a remarkable sensitivity to surface structure. Three-dimensional Cu clusters, well-ordered two dimensional Cu islands and isolated Cu atoms are distinctively characterized by their CO IR peaks. In addition, both disorder-order and order-order transitions are observed for the metal overlayers on the single crystal metal substrates. It was also observed that localized segregation and ordering of mixed CO and S overlayers on a Mo(110) substrate occurs upon annealing. GRA

N93-19974*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ON THE DRAG OF MODEL DENDRITE FRAGMENTS AT LOW REYNOLDS NUMBER
R. Zakhem (Colorado Univ., Boulder.), P. D. Weidman (Colorado Univ., Boulder.), and H. C. deGroh, III Feb. 1993 36 p Previously announced in IAA as A92-50868
(RTOP 674-27-05)
(NASA-TM-105916; E-7583; NAS 1.15:105916) Avail: CASI HC A03/MF A01

An experimental study of low Reynolds number drag on laboratory models of dendrite fragments has been conducted. The terminal velocities

of the dendrites undergoing free fall along their axis of symmetry were measured in a large Stokes flow facility. Corrections for wall interference give nearly linear drag vs Reynolds number curves. Corrections for both wall interference and inertia effects show that the dendrite Stokes settling velocities are always less than that of a sphere of equal mass and volume. In the Stokes limit, the settling speed ratio is found to correlate well with primary dendrite arm aspect ratio and a second dimensionless shape paremeter which serves as a measure of the fractal-like nature of the dendrite models. These results can be used to estimate equiaxed grain velocities and distance of travel in metal castings. The drag measurements may be used in numerical codes to calculate the movement of grains in a convecting melt in an effort to determine macrosegregation patterns caused by the sink/float mechanism. Author

N93-20024# EG and G Rocky Flats, Inc., Golden, CO.
APPLICATION OF SURROGATE MATERIALS IN PROCESS STUDY OF ACTINIDES
A. Raraz, B. Mishra, and W. A. Averill 1992 8 p Presented at the Annual Meeting of The Metallurgical Society, Denver, CO, 21-25 Feb. 1993
(Contract DE-AC34-90DP-62349)
(DE93-002257; RFP-4628; CONF-930202-1) Avail: CASI HC A02/MF A01

Measurement of process parameters in reactive metals processing, such as actinides, is extremely difficult due to dynamic nature of system operating at high temperatures and under protective atmospheres. In addition, performing studies with radioactive strategic metals is, generally, prohibitively expensive with significant safety concerns. The use of cerium metal to simulate the pyrometallurgical characteristics of plutonium is discussed. Design parameters relating to ceramic component arrangement, process parameters relating to electrolyte behavior and operating parameters relating to cell temperature, anode stirring speed, current density, and back emf for electrorefining were studied. Molten tin, gallium, iodine, and antimony-cadmium alloy were also used to study the different parameters involved. Validity and justification of these measurements is discussed. DOE

N93-20025# Sandia National Labs., Albuquerque, NM.
DISSIPATION IN ADIABATIC SHEAR BANDS
D. E. Grady 1992 10 p Presented at the Society of Engineering Science (SES) Technical Meeting, San Diego, CA, 14-16 Sep. 1992
(Contract DE-AC04-76DP-00789)
(DE93-002280; SAND-92-0921C; CONF-9209240-2) Avail: CASI HC A02/MF A01

In adiabatic shear banding in metals, the region of interest is modelled as a two-material two-temperature body. Specific material laws governing thermoviscous plasticity and heat transfer are ascribed to the shear-band zone. Momentum and energy balance lead to a system of one-dimensional ordinary differential equations describing the dynamics of the shear localization process. The propagating shear band is viewed as having two distinct regions. The first is the shear-band tip process zone within which adiabatic heating, thermal softening, and all shear dissipation are considered to occur. The second is the late-time quasi-steady zone in which the shear stress and dissipation rate are close to zero. The analysis provides the width and displacement of the shear band process zone. In addition, criteria for assessing material shear-banding resistance are investigated in terms of a shear-band dissipation rate, or a shear-band toughness. Shear-band dissipation and shear-band toughness for a number of metals are calculated and compared. DOE

N93-20062# Ecole Centrale de Lyon (France).
STUDY AND DEVELOPMENT OF OHMIC CONTACTS ON n AND p TYPE INDIUM PHOSPHIDE BY AUTOCATALYTIC CHEMICAL DEPOSITION OF METALS AND ALLOYS Ph.D. Thesis [ETUDE ET REALISATION DE CONTACTS OHMIQUES SUR LE PHOSPHURE D'INDIUM DE TYPE N ET P PAR DEPOT CHIMIQUE AUTOCATALYTIQUE DE METAUX ET D'ALLIAGES]
Youming WangLi 1992 164 p In FRENCH
(ECL-92-23; ETN-93-93054) Avail: CASI HC A08/MF A02

The purpose of the investigation was to develop ohmic contacts on both n and p type indium phosphide semiconductors by chemical deposition in aqueous media. Indium phosphide is a brittle material and most ohmic contacts usually obtained by physical deposition processes have short lifetimes. Another objective of the work is to produce thermodynamically stable and high temperature resistant contacts. The theory of metal semiconductor contacts is reviewed. Methods of obtaining ohmic contact from semiconductors of type three and four are summarized. Three chemical deposition processes, based on oxidation-reduction reactions, are discussed: electrolytic deposition, deposition by charge migration and autocatalytic (electrodeless) chemical deposition. The physico chemical behavior of the indium phosphide base ohmic contacts were analyzed by scanning electron microscopy and small angle X-ray diffraction, Auger electron spectroscopy, and gamma-ray emission. The results show that the proposed method is suitable to develop high quality ohmic contacts. ESA

N93-20275# Pratt and Whitney Aircraft, West Palm Beach, FL. Government Engines and Space Propulsion.
FATIGUE IN SINGLE CRYSTAL NICKEL SUPERALLOYS Technical Progress Report, 16 Nov. - 15 Dec. 1992
Charles Annis 17 Dec. 1992 8 p
(Contract N00014-91-C-0124)
(AD-A259191; PW/FR-21998-14) Avail: CASI HC A02/MF A01

This program investigates the seemingly unusual behavior of single crystal airfoil materials. The fatigue initiation processes in single crystal (SC) materials are significantly more complicated and involved than fatigue initiation and subsequent behavior of a (single) macrocrack in conventional isotropic materials. To understand these differences is the major goal of this project. GRA

N93-21488# California Univ., Berkeley. Lawrence Berkeley Lab.
NEW DEVELOPMENTS IN THE 'AB INITIO' DETERMINATION OF TRANSITION METAL ALLOY PHASE DIAGRAMS
C. Wolverton (California Univ., Berkeley.), M. Asta (California Univ., Berkeley.), S. Quannasser (Nancy Univ., France.), H. Dreysse (Nancy Univ., France.), and D. deFontaine (California Univ., Berkeley.) Apr. 1992 8 p Presented at the Thermodynamics of Alloys 1992, Nancy, France, 28 Apr. - 1 May 1992
(Contract DE-AC03-76SF-00098)
(DE93-002540; LBL-32827; CONF-9204214-1) Avail: CASI HC A02/MF A01

Certain classes of temperature-composition binary alloy phase diagrams can now be computed in an 'ab-initio' approach. No adjustable or experimentally fitted parameter is used. The expectation value of the energy is expressed in terms of an expansion of cluster probabilities, where the prefactors, the Effective Cluster Interaction, are related to the alloy electronic structure. This framework is used to study the MoRe alloy for two situations: bulk and semi-infinite crystal bounded by a (001) surface. In both cases, good agreement with experimental data is found. DOE

N93-21497# Health Effects Research Lab., Research Triangle Park, NC.
SOME CONSTITUTIVE MODIFIERS OF THE KINETIC AND DYNAMIC BEHAVIOR OF NON-ESSENTIAL METALS
D. J. Thomas 23 Jul. 1992 23 p
(PB92-227347; EPA/600/A-89/189) Avail: CASI HC A03/MF A01

In addition to the variety of extrinsic (e.g., environmental, nutritional, and experimental) factors which can influence the kinetic and dynamic behavior of non-essential metals, certain intrinsic or constitutive characteristics of the host organism can influence the distribution, metabolism and toxic effects of these metals. An important task in metal toxicology is identification of these constitutive factors and elucidation of the molecular bases or organismic differences in the kinetic and dynamic behavior of non-essential metals. Understanding of these differences increases the knowledge of the physiological processes controlling metal disposition and improves the accuracy of the assessment of hazard associated with exposure to non-essential metals. The incorporation of these constitutive factors into the modeling of the kinetic behavior of non-essential metals will improve the descriptive and predictive value of the models. GRA

N93-21551 GKSS-Forschungszentrum Geesthacht (Germany). Inst. fuer Werkstofforschung.
FATIGUE CRACK PROPAGATION OF TITANIUM ALLOYS IN SALT WATER [ERMUEDUNGSRISSAUSBREITUNG VON TITANLEGIERUNGEN IN SALZWASSER]
J. K. Gregory 1991 11 p Repr. from Deutscher Verband fuer

Materialforschun27 Feb. 1991 In GERMAN Presented at 23rd Vortragsveranstaltung des DVM-Arbeitskreises Bruchvorgaenge, Berlin, Germany, F.R., 26-27 Feb. 1991
(GKSS-91/E/46; ETN-93-92589) Copyright Avail:
GKSS-Forschungszentrum Geesthacht G.M.B.H., Germany, F.R.

The frequency dependence of crack propagation behavior is characterized for alpha and alpha plus beta titanium alloys in a 3.5 NaCl Solution. Material and experimentation are described. Results are given and discussed. It is shown that fatigue crack propagation of titanium alloys in an aqueous sodium chloride solution is produced by a superposition of corrosion fatigue and stress corrosion cracking. ESA

N93-21772# Los Alamos National Lab., NM.
THE BEHAVIOR OF INTERMETALLIC COMPOUNDS AT LARGE PLASTIC STRAINS
G. T. Gray, III and J. D. Embury (McMaster Univ., Hamilton, Ontario.) 1992 7 p Presented at the Material Research Society Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract W-7405-eng-36)
(DE93-003820; LA-UR-92-3715; CONF-921101-5) Avail: CASI HC A02/MF A01

Much effort has been devoted to the study of ordered materials at modest plastic strains and the problem of premature failure. However by utilizing stress states other than simple tension it is possible to study the deformation of intermetallic compounds up to large plastic strains and to consider the behavior of these materials in the regime where stresses approach the theoretical stress. The current work outlines studies of the work hardening rate of a number of titanium and nickel-based intermetallic compounds deformed in compression. Attention is given to the structural basis of the sustained work hardening. The large strain plasticity of these materials is summarized in a series of diagrams. Fracture in these materials in compression occurs via catastrophic shear at stresses of the order of E/80 (where E is the elastic modulus). DOE

N93-21773# Oak Ridge National Lab., TN.
THE APPLICATION OF QUALITY CRITERIA FOR THE PREDICTION OF POROSITY IN THE DESIGN OF CASTING PROCESSES
S. Viswanathan, V. K. Sikka, and H. D. Brody (Connecticut Univ., Storrs.) 1993 8 p Presented at the 6th Modeling of Casting, Welding, and Advanced Solidification Processes Conference, Palm Coast, FL, 21-26 Mar. 1993
(Contract DE-AC05-84OR-21400)
(DE93-001719; CONF-930360-1) Avail: CASI HC A02/MF A01

Solidification parameters calculated from temperature measurements and experimentally determined distributions of porosity in gain-refined Al-4.5 percent Cu alloy castings are linked to provide quality criteria for the prediction of porosity in the computer-aided design and analysis of casting processes. The quality criteria applicable to a particular casting process are dependent on the thermal conditions and the solidification mode of the alloy. Accordingly, casting processes and alloy types are divided into four groups according to whether porosity distribution is dominated by liquid transport, dendrite structure, or bubble pressure, and a different set of quality criteria is obtained for each group. Results from test castings of Al-4.5 percent Cu alloy cast in a variety of configurations and mold media are used to develop models and extract quality criteria. The results obtained on Al-4.5 percent Cu alloy are tested on data on Al-7 percent Si-0.3 percent Mg alloy castings reported in the literature. The results show that the quality criteria developed for USSR Cu alloy are also applicable to other alloy systems. The procedure for applying quality criteria for the prediction of microporosity distributions in commercial casting processes is outlined. DOE

N93-21779# Los Alamos National Lab., NM.
FRACTURE AT Cu/SAPPHIRE INTERFACES
I. E. Reimanis, B. J. Dalgleish (California Univ., Berkeley.), and K. P. Trumble (Purdue Univ., West Lafayette, IN.) 1992 11 p Presented at the Ceramic Science and Technology Congress and Exposition, San Francisco, CA, 1-4 Nov. 1992
(Contract W-7405-eng-36)
(DE93-003816; LA-UR-92-3682; CONF-921128-2) Avail: CASI HC A03/MF A01

Crack propagation at diffusion bonded Cu/(alpha)-Al2O3 interfaces was studied in situ in the optical microscope using a delamination specimen geometry. Chemical reactions between Cu and Al2O3 during diffusion bonding produce discrete interphases at the interface which effect the fracture behavior. The measured fracture energies depends on the thickness of the Cu layer in the sandwich geometry: (Gamma)(sub i) is approximately 110 J/sq m for 130 microns Cu thicknesses while (Gamma)(sub i) is approximately 70 J/sq m for the 25 micron Cu thicknesses. Considerable roughening through crack face bridging by the discrete interphases is observed. Two different models which describe the toughening are discussed. DOE

N93-21958# Brookhaven National Lab., Upton, NY.
HIGH-ENERGY SPIN-DENSITY-WAVE CORRELATED FLUCTUATIONS IN PARAMAGNETIC Cr + 5 at. PERCENT V
S. A. Werner (Missouri Univ., Columbia.), E. Fawcett (Toronto Univ., Ontario.), M. W. Elmiger, and G. Shirane 1992 10 p Presented at the Conference on Magnetism and Magnetic Materials, Houston, TX, 1-4 Dec. 1992
(Contract DE-AC02-76CH-00016)
(DE93-003165; BNL-48026; CONF-921201-7) Avail: CASI HC A02/MF A01

Measurements of the magnetic fluctuations, termed spin-density-wave (SDW) paramagnons, in the nearly antiferromagnetic alloy Cr + 5 at. percent V are extended up in energy to about 80 MeV. These fluctuating spin-spin correlations occur at incommensurate positions, corresponding to the SDW wavevector Q. Their characteristic energy is at least an order of magnitude larger than that of the magnetic fluctuations seen in the paramagnetic phase of pure Cr, but their intensity is more than two orders of magnitude smaller. We find that the dynamic susceptibility decreases by about 50 percent between temperature T = 10 and 300 K. DOE

N93-21972# Sandia National Labs., Albuquerque, NM.
ROLE OF ATOMIC SIZE AND VALENCE IN BONDING AND DIFFUSION AT METAL SURFACES
P. J. Feibelman 1992 5 p Presented at the Material Research Society Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract DE-AC04-76DP-00789)
(DE93-003994; SAND-92-2408C; CONF-921101-8) Avail: CASI HC A01/MF A01

First-principles calculations and corresponding experimental results underline the importance of basic chemical concepts in understanding bonding and diffusion of atoms at and on metal surfaces. Examples discussed include the outward relaxation of clean KBe(0001), the separation energies of metal-adatom dimers, concerted substitutional self-diffusion on fcc(001) and (110) surfaces, and adsorption and diffusion barrier sites for adatoms near steps. DOE

N93-21985# Argonne National Lab., IL. Materials and Components Technology Div.
STRESS CORROSION CRACKING SUSCEPTIBILITY OF IRRADIATED TYPE 304 STAINLESS STEELS
H. M. Chung, W. E. Ruther, J. E. Sanecki, and T. F. Kassner Aug. 1992 19 p Presented at the 16th ASTM International Symposium on the Effects of Radiation on Materials (ISERM), Aurora, CO, 23-25 Jun. 1992
(Contract W-31-109-eng-38)
(DE93-003005; ANL/MCT/CP-74743; CONF-9206282-2) Avail: CASI HC A03/MF A01

Slow-strain-rate tensile tests and microstructural analysis by Auger electron spectroscopy were conducted on specimens of high- and commercial-purity (HP and CP) heats of Type 304 stainless steel obtained from neutron absorber tubes and a control blade sheath after irradiation up to 2.5 x 10(exp 21) n-sq cm (E is greater than 1 MeV) in boiling water reactors (BWR's). The susceptibility of the HP absorber tubes to intergranular stress corrosion cracking (IGSCC) was higher than that of the CP absorber tubes or the CP control blade sheath. IGSCC susceptibilities of the BWR components could not be correlated to segregation impurities on grain boundaries. However for comparable fluence levels, the susceptibilities could be correlated to concentrations of Cr on grain-boundaries. DOE

N93-21986# Ames Lab., IA.
NEW PATHWAYS TO TUNGSTEN AND MOLYBDENUM OXIDES, NITRIDES, AND AZIDES Ph.D. Thesis

M. R. Close Oct. 1992 191 p
(Contract W-7405-eng-82)
(DE93-003051; IS-T-1608) Avail: CASI HC A09/MF A02

Trichloronitridotungsten (VI) ((WNCl3)4) was prepared and characterized structurally by X-ray diffraction. Trichloronitridotungsten (VI) crystallizes in space group P(bar-1) as planar 8-membered W-N rings interconnected through chloride bridges. The inter-tetramer linkage is weak and broken easily to accommodate basic ligands in the site trans to the W-N triple bond. Reactivity of WNCl3, with nitriding agents, such as ammonia, trimethylsilylazide and lithium nitride, has been investigated, which resulted in preparation of new tungsten azido and nitrido compounds. Second, the reactivity of the metal dimers MO2(O2CCH3)4 and MO2Cl4py(sub 4) with trimethylsilylazide has been explored, and the reactions in pyridine were found to yield a material corresponding to the formulation, MoN(N3)py. Thermolytic decomposition of this azide at 280 C was performed under argon, dynamic vacuum or ammonia. Thermal decomposition in ammonia produces a molybdenum nitride relatively free of carbon with a Mo:N ratio of 1:1.8. WNCl3 was converted into a hexagonal ammonium tungsten bronze, ((NH4)0.28)WO(3-y)NH(y). This synthesis increased the probability of isoelectronic imido substitution for oxide in the bronze framework. Rietveld refinements of neutron powder data indicated strongly that nitrogen, in the form of imide, does not substitute for oxygen. A model for ammonium cation motion in the hexagonal channels of the bronze was developed. Electrical resistivity measurements on a pressed pellet of this hexagonal bronze show a temperature dependence like that of a low-band gap semiconductor, in contrast to conventionally prepared metallic hexagonal bronze phases. DOE

N93-22001# Oak Ridge National Lab., TN.
COVALENT NITRIDES FOR MASKLESS LASER WRITING OF MICROSCOPIC METAL LINES
L. Maya 1992 7 p Presented at the Material Research Society Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract DE-AC05-84OR-21400)
(DE93-004105; CONF-921101-11) Avail: CASI HC A02/MF A01

Selected covalent metal nitrides with limited thermal stability, such as Sn3N4, Cu3N, and Ni3N, were prepared in a glow discharge system by reactive sputtering in a nitrogen plasma. These compounds were characterized by chemical analysis and their thermal behavior established by temperature-programmed thermal decomposition. These materials decompose into the elements with the rate reaching a maximum at 615, 465, and 405 C for Sn, Cu, and Ni respectively. The feasibility of using these coatings to generate metal lines by maskless laser writing was explored. Conducting metal lines, a few micron in width, could be generated with each of these nitrides. The resistivities of the metal lines were within an order of magnitude of those of the bulk metals for Cu and Ni and somewhat more for Sn. DOE

N93-20626# Manitoba Univ., Winnipeg. Dept. of Mechanical Engineering.
HIGH TEMPERATURE ALLOYS
M. C. Chaturvedi, N. L. Richards (Bristol Aerospace Ltd., Winnipeg, Manitoba.), and R. Nakkalil *In its* Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 102-113 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20694# Tokyo Inst. of Tech. (Japan). Dept. of Aerospace Engineering.
ANALYSIS OF HYSTERESIS IN SHAPE MEMORY ALLOYS DURING THERMAL CYCLIC LOADING
Kikuaki Tanaka and Hisaaki Tobushi (Aichi Inst. of Tech., Toyota, Japan.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 604-605 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20695# Aichi Inst. of Tech., Toyota (Japan).
DEFORMATION OF TiNi SHAPE MEMORY ALLOY UNDER THERMOMECHANICAL CYCLES
H. Tobushi, H. Iwanaga, K. Tanaka (Tokyo Inst. of Tech., Japan.), T. Hori, and T. Sawada *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 606-607 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-21121# McGill Univ., Montreal (Quebec). Dept. of Mathematics and Statistics.
INTERFACIAL WAVE THEORY ON FORMATION OF DENDRITIC STRUCTURE IN BINARY ALLOY SYSTEM
Jian-Jun Xu *In* Canadian Space Agency, Spacebound 1991 1991 p 261-264 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

N93-20041*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
IMPROVED CERAMIC SLIP CASTING TECHNIQUE Patent Application
Gregory M. Buck, inventor (to NASA) and Peter Vasquez, inventor (to NASA) 22 Sep. 1992 9 p
(NASA-Case-LAR-14471-1; NAS 1.71:LAR-14471-1; US-Patent-Appl-SN-950580) Avail: CASI HC A02/MF A01

A primary concern in modern fluid dynamics research is the experimental verification of computational aerothermodynamic codes. This research requires high precision and detail in the test model employed. Ceramic materials are used for these models because of their low heat conductivity and their survivability at high temperatures. To fabricate such models, slip casting techniques were developed to provide net-form, precision casting capability for high-purity ceramic materials in aqueous solutions. In previous slip casting techniques, block, or flask molds made of plaster-of-paris were used to draw liquid from the slip material. Upon setting, parts were removed from the flask mold and cured in a kiln at high temperatures. Casting detail was usually limited with this technique -- detailed parts were frequently damaged upon separation from the flask mold, as the molded parts are extremely delicate in the uncured state, and the flask mold is inflexible. Ceramic surfaces were also marred by 'parting lines' caused by mold separation. This adversely affected the aerodynamic surface quality of the model as well. (Parting lines are invariably necessary on or near the leading edges of wings, nosetips, and fins for mold separation. These areas are also critical for flow boundary layer control.) Parting agents used in the casting process also affected surface quality. These agents eventually soaked into the mold, the model, or flaked off when releasing the case model. Different materials were tried, such as oils, paraffin, and even an algae. The algae released best, but some of it remained on the model and imparted an uneven texture and discoloration on the model surface when cured. According to the present invention, a wax pattern for a shell mold is provided, and an aqueous mixture of a calcium sulfate-bonded investment material is applied as a coating to the wax pattern. The coated wax pattern is then dried, followed by curing to vaporize the wax pattern and leave a shell mold of the calcium sulfate-bonded investment material. The shell mold is cooled to room temperature, and a ceramic slip is poured therein. After a ceramic shell of desired thickness has set up in the shell mold, excess ceramic slip is poured out. While still wet, the shell mold is peeled from the ceramic shell to expose any delicate or detailed parts, after which the ceramic shell is cured to provide a complete, detailed, precision ceramic article without parting lines. NASA

N93-20122# Department of the Navy, Washington, DC.
HIGH TEMPERATURE SUBSTRATE MOUNT FOR CHEMICAL VAPOR DEPOSITION OF DIAMOND Patent Application
J. E. Butler, inventor (to Navy) and K. Doversprike, inventor (to Navy) 30 Sep. 1992 22 p
(AD-D015563; US-Patent-Appl-SN-953908; Navy-Case-73518) Avail: CASI HC A03/MF A01

This patent application discloses an apparatus for the chemical vapor

deposition of diamond on a substrate seed crystal. The seed crystal is held by vacuum suction on a mount, while the chemical vapor deposition of diamond is carried out on the substrate seed crystal. GRA

N93-20276 Department of the Navy, Washington, DC.
STABILIZED ZIRCONIA/CoCrAlY HIGH TEMPERATURE COATING Patent
Charles M. Gilmore, inventor (to Navy), Earl F. Skelton, inventor (to Navy), Louis F. Aprigliano, inventor (to Navy), and Syed B. Qadri, inventor (to Navy) 15 Sep. 1992 3 p Filed 11 Sep. 1991
(AD-D015573; US-Patent-5,147,731; US-Patent-Appl-SN-759149) Avail: US Patent and Trademark Office

A corrosion resistant structure having an outer ceramic layer of alumina stabilized zirconia resistant to oxidation at high temperatures, over a base alloy selected from the group consisting of CoCrAlY and NiCrAlY and applied to the base alloy by physical vapor deposition process, such as reactive magnetron sputtering wherein the outer ceramic layer has a thickness of from about 0.5 micrometers to about 200 micrometers is presented. GRA

N93-20300*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
OXYGEN PLASMA RESISTANT PHOSPHINE OXIDE CONTAINING IMIDE/ARYLENE COPOLYMERS
Brian J. Jensen Jan. 1993 12 p
(RTOP 506-43-11)
(NASA-TM-107712; NAS 1.15:107712) Avail: CASI HC A03/MF A01

A series of oxygen plasma resistant imide/arylene ether copolymers were prepared by reacting anhydride-terminated poly(amide acids) and amine-terminated polyarylene ethers containing phosphine oxide units. Inherent viscosities for these copolymers ranged from 0.42 to 0.80 dL/g. After curing, the resulting copolymers had glass transition temperatures ranging from 224 C to 228 C. Solution cast films of the block copolymers were tough and flexible with tensile strength, tensile moduli, and elongation at break up to 16.1 ksi, 439 ksi, and 23 percent, respectively at 25 C and 9.1 ksi, 308 ksi and 97 percent, respectively at 150 C. The copolymers show a significant improvement in resistance to oxygen plasma when compared to the commercial polyimide Kapton. The imide/arylene ether copolymers containing phosphine oxide units are suitable as coatings, films, adhesives, and composite matrices. Author

N93-20304 Department of the Navy, Washington, DC.
METAL-COATED, ORDERED VOID PIEZOELECTRIC CERAMIC MATERIAL Patent
Manfred Kahn, inventor (to Navy) 11 Aug. 1992 8 p Filed 27 Nov. 1990
(AD-D015540; US-Patent-5,137,776; US-Patent-Appl-SN-588908) Avail: US Patent and Trademark Office

An ordered void piezoelectric ceramic material (e.g. lead zirconate titanate (PZT)) has its inner void surfaces coated with a thin flexible layer of a metal (e.g. silver) by a process which includes the following steps. First a quantity of an ordered void piezoelectric ceramic material is obtained. Next, the ordered void piezoelectric ceramic material is impregnated with a solution containing a metal, such that inner surfaces of the voids of the ceramic material are wetted with the impregnating solution. Then, excess impregnating solution is removed from the external edges of the piezoelectric ceramic material, leaving the inner surfaces of the voids wetted with impregnating solution. Then, the void-wetted piezoelectric ceramic material is fired to bring about formation of a thin flexible metal coating on the inner surfaces of the voids of the piezoelectric ceramic material. GRA

N93-20398# Department of the Navy, Washington, DC.
POLYMERS OF BIS(ETHYNYLSTYRYL)BENZENE AND RELATED MONOMERS Patent Application
Theodore R. Walton, inventor (to Navy) 30 Jun. 1992 19 p
(AD-D015612; US-Patent-Appl-SN-906344; Navy-Case-72965) Avail: CASI HC A03/MF A01

Monomers, B-stage polymers, C-stage polymers, cured polymers, and electrically conducting polymers of acetylene-terminated aromatic monomers containing three benzene rings separated by ethylene groups are disclosed. These new polymers can withstand aggressive environments and are particularly adapted for use in high temperature composites in addition to the utilization of their electrical conducting properties. Preparation of these materials is accomplished by melt polymerization and heat treatment at high temperatures. GRA

N93-20542# Ecole Centrale de Lyon (France). Dept. de Materiaux-Mecanique-Physique.
ADHERENCE AND REACTIVITY OF GRAPHITE BASE MULTIMATERIALS Ph.D. Thesis [ADHERENCE ET REACTIVITE DES MULTIMATERIAUX A BASE DE GRAPHITE]
Hamid Ajrhourh 1992 131 p In FRENCH
(ECL-92-04; ETN-93-93050) Avail: CASI HC A07/MF A02

A study to develop and characterize several graphite base multilayered materials is presented. These laminates consist of several superimposed metal, carbide or oxide and graphite layers. The best conditions, concerning the adhesion and reactivity between graphite and the other component materials, were established from theoretical investigations and results obtained by other authors. The aim was to provide optimal manufacturing procedures in order to protect graphite from high temperature oxidation. The materials applied are metal (chromium, molybdenum, aluminum, silicon)/graphite, aluminum/silicon or chromium carbide/graphite, aluminum or zirconium oxides/graphite, aluminum or zirconium oxides/chromium or silicon carbides/graphite. Thermocompression, slurry-coating and plasma deposition manufacturing techniques were developed. The mechanical and physico chemical properties as well as interface morphology are analyzed. ESA

N93-20566*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ATOMIC OXYGEN PROTECTIVE COATING WITH RESISTANCE TO UNDERCUTTING AT DEFECT SITES Patent Application
Bruce A. Banks, inventor (to NASA) and Sharon K. Rutledge, inventor (to NASA) 6 Jul. 1992 15 p
(NASA-Case-LEW-15306-1; NAS 1.71:LEW-15306-1;
US-Patent-Appl-SN-909345) Avail: CASI HC A03/MF A01

Structures composed at least partially of an organic substrate may be protected from oxidation by applying a catalyst onto said substrate for promoting the combination of atomic oxygen to molecular oxygen. The structure may also be protected by applying both a catalyst and an atomic oxygen shielding layer onto the substrate. The structures to be protected include spacecraft surfaces. NASA

N93-20567*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
IMIDE/ARYLENE ETHER COPOLYMERS CONTAINING PHOSPHINE OXIDE GROUPS Patent Application
Brian J. Jensen, inventor (to NASA) 20 Nov. 1992 19 p
(NASA-Case-LAR-14925-1; NAS 1.71:LAR-14925-1;
US-Patent-Appl-SN-990570) Avail: CASI HC A03/MF A01

Anhydride terminated poly(amic acids) are reacted with amine terminated phosphine oxide containing poly(arylene ethers) in polar aprotic solvents to form poly(amic acids) which are cyclodehydrated yielding atomic oxygen resistant imide/arylene ether block copolymers. The resulting block copolymers exhibited excellent resistance to oxygen plasma etching and improved tensile strength and modulus, making them useful for films, coatings, adhesives and composite matrices for low earth orbit applications. NASA

N93-20786 Department of the Navy, Washington, DC.
METHOD TO PRODUCE CERAMIC SUPERCONDUCTING FILAMENTS BONDED TO METALS Patent
Louis F. Aprigliano, inventor (to Navy) and Richard J. Stockhausen, inventor (to Navy) 17 Nov. 1992 8 p Filed 29 Jun. 1989
(AD-D015595; US-Patent-5,164,361; US-Patent-Appl-SN-373072) Avail: US Patent and Trademark Office

A method for making superconducting ceramic filaments by joining the ceramic to a normal conducting metal in such a way that minimal mechanical working, drawing, or extrusion is needed to arrive at a fine filamentary shape is presented. GRA

N93-20909# Technische Univ., Delft (Netherlands).
AMORPHOUS Mo/Si MULTILAYERS: INTERDIFFUSION AND STRUCTURAL RELAXATION; CRYSTALLIZATION Ph.D. Thesis

Onno Bram Loopstra 1992 109 p Sponsored by Innovatief Onderzoeks Project IC-Technologie
(ETN-93-92992) Avail: CASI HC A06/MF A02

The relation between structure and properties of amorphous Mo/Si multilayers on annealing is considered. Crystallization and the subsequent phase transformations are dealt with. To this end the Mo/Si multilayers were used simply as starting material for production of (crystalline) molybdenum silicide. As a result an overview of the behavior of these Mo/Si multilayers upon annealing was obtained. The coupled behavior of stress, interdiffusion, and structural relaxation in the amorphous film are also dealt with. The multilayer character of the specimens and the presence of the substrate played an important role in the acquisition of relevant data, as exhibited in the diffusion and thickness measurements, by use of x ray diffraction, and in the stress measurements, by use of an optical technique for measuring the radius of curvature of the substrate, respectively. The measurements were interpreted in terms of the free volume model. ESA

N93-21030# National Inst. of Standards and Technology, Gaithersburg, MD. Ceramics Div.
HIGH-TEMPERATURE FLEXURE FIXTURE FOR ADVANCED CERAMICS
George D. Quinn Jun. 1992 26 p
(PB92-222959; NISTIR-4864) Avail: CASI HC A03/MF A01

A test fixture for elevated temperature flexure strength testing is presented. The fixture is suitable for fast fracture or stress rupture experiments up to 1500 C in air or inert environments. GRA

N93-21041# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Inst. fuer Flugfuehrung.
ION SOURCE AHKS-30 [IONENQUELLE AHKS-30]
Guenther Au Oct. 1991 23 p In GERMAN
(DLR-Mitt-91-20; ETN-93-91920) Avail: CASI HC A03/MF A01; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

An ion source for sputtering and cleaning of material surfaces by argon ions, in the range from 50 eV to 1.25 keV, is reported. The ion source is a further development of several thrusters called ESKA, which were previously tested. In these cases, mercury was used as a propellant. Argon is currently used for ionization in the sputtering experiments. Several parts of the source are made of graphite as this chemical element had the lowest sputtering rate of all known elements. The special design of the cathode and anode system shows a much longer heating wire lifetime. ESA

N93-21189*# Cleveland State Univ., OH.
SYNTHESES, STRUCTURES AND PROPERTIES OF POLYCARBOSILANES FORMED DIRECTLY BY POLYMERIZATION OF ALKENYLSILANES
John Masnovi, Xin Y. Bu, Kassahun Beyene, Paula Heimann, Terrence Kacik, A. Harry Andrist, and Frances I. Hurwitz (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.) [1993] 21 p
(Contract NCC3-63)
(NASA-CR-191927; NAS 1.26:191927) Avail: CASI HC A03/MF A01

Vinylsilane polymerizes to form predominantly a carbosilane polymer using dimethyltitanocene catalyst. This is in contrast to alkylsilanes, which afford polysilanes under the same conditions. The mechanism of polymerization of alkenylsilanes has been shown to be fundamentally different from that for the polymerization of alkylsilanes. The silyl substitute apparently activates a double bond to participate in a number of polymerization processes in this system, particularly hydrosilation. Isotopic labeling indicates the involvement of silametallocyclic intermediates, accompanied by extensive nuclear rearrangement. Polymers and copolymers derived from alkenylsilanes have relatively high char yields even for conditions which afford low molecular weight distributions. Formation of crystalline beta-SiC is optimum for a copolymer of an alkylsilane and an alkenylsilane having a silane/carbosilane backbone ratio of 85/15 and a C/Si ratio of 1.3/1. Author (revised)

N93-21252# Industrial Filter and Pump Mfg. Co., Cicero, IL.
ADVANCED LIGHTWEIGHT CERAMIC CANDLE FILTER MODULE
J. F. Zievers and P. Eggerstedt 1992 12 p Presented at the US Department of Energy Contractors Review Meeting on Gasification and Gas Stream Cleanup Systems, Morgantown, WV, 15-17 Sep. 1992
(Contract DE-FG02-92ER-81349)
(DE93-000211; DOE/ER-81349/93/C0125; CONF-920951-39) Avail: CASI HC A03/MF A01

To determine the economic effect of light weight ceramics, several sizes of filters were cost estimated for operation at 217.5 psi (15 bar) based on the use of all light weight ceramics (Fibro/Fibro) vs. the use of cooled alloy (RA300) tubesheets and silicon carbide candles (Alloy/SiC). A jet pulse delivery system was included in both estimates. The Fibro/Fibro system was estimated with the plenum design while the Alloy/SiC system was based on header/nozzle design. Battery limits were the filters and jet pulse delivery systems, Ex-works, with no main valves or dust removal systems. It was found that the cost of Fibro/Fibro components were consistently lower than the cost of the Alloy/SiC components. DOE

N93-21266# Pennsylvania Univ., Philadelphia. Dept. of Chemistry.
THE POLYANILINES: A NOVEL CLASS OF CONDUCTING POLYMERS Technical Report, 31 May 1991 - 30 Jun. 1992
Alan G. MacDiarmid 19 Jun. 1992 42 p
(Contract N00014-90-J-1559)
(AD-A259386; TR-1992-35) Avail: CASI HC A03/MF A01

The synthesis and p- and n-doping of polyacetylene, (CH)x, the prototype conducting polymer or 'synthetic metal' is described together with a qualitative description of its band structure and changes in band structure on doping to yield positive and negative solitons. Other conducting polymers are briefly discussed. The polyanilines, a large class of versatile conducting polymers involving a novel non-redox doping process, considered as being of significant commercial technological importance are discussed in particular with reference to their ease of processing. Present and future technological uses of conducting polymers are noted. GRA

N93-21471# National Inst. of Standards and Technology, Gaithersburg, MD. Polymers Div.
MEASUREMENT OF THE DIELECTRIC CONSTANT OF POLYMERIC FILMS AT HIGH FIELDS Final Report, Sep. 1992
Frederick I. Mopsik and Brian Dickens Sep. 1992 52 p
(PB92-238625; NISTIR-4910) Avail: CASI HC A04/MF A01

A generalized method for measuring the dielectric constant of a film at high applied fields is outlined. By using a low output impedance generator and a zero input voltage charge amplifier, a three-terminal configuration becomes possible. This method allows a complete specimen shielding. It also removes from the measured parameters any influence of the connecting leads. The measurement advantages of using a charge amplifier are discussed. A design for the charge amplifier is given that provides good immunity from any damage if the sample should experience an electrical breakdown. An extensive error analysis of the method is provided. Results are presented that show data with an uncertainty of less than 1 percent are possible in well defined samples. GRA

N93-21491# Westinghouse Electric Corp., Pittsburgh, PA. Science and Technology Center.
THERMAL/CHEMICAL STABILITY OF CERAMIC CROSS FLOW FILTER MATERIALS
M. A. Alvin, D. M. Bahovchin, T. E. Lippert, R. E. Tressler, and K. B. McNerney 1992 20 p Presented at the US Department of Energy Contractors Review Meeting on Gasification and Gas Stream Cleanup Systems, Morgantown, WV, 15-17 Sep. 1992
(Contract DE-AC21-88MC-25034)
(DE93-002710; DOE/MC-25034/93/C0096; CONF-920951-16) Avail: CASI HC A03/MF A01

Westinghouse has undertaken a two phase program to determine possible long-term, high temperature influence that advanced coal-based power system environments may have on the stability of the ceramic cross flow filter elements. During the past year, efforts focused on developing an understanding of the stability of the alumina/mullite filter material at high temperature (i.e., 870, 980, and 1100 C) under oxidizing conditions which contain gas phase aikali species. The alumina/mullite cross flow filter material that was consistently used throughout the flow-through gas phase alkali testing segment of this program, consists of mullite rods or needles that are embedded within an amorphous phase which contains corundum Al2O3 and anorthite CaAl2Si2O8. Due to the rapid cooling rate

that was used to produce the alumina/mullite filter disc material from high fire, the matrix consists of 59.6 wt percent mullite, 30.5 wt percent amorphous, 5.1 wt percent anorthite, and 4.8 wt percent alumina. The relatively low, as-fabricated, hot strength of this material (841 plus or minus 259 psi at 870 C) is a direct result of the high amorphous content which softens at temperatures of 870 C. Load versus deflection curves as a function of temperature indicate that this material is relatively brittle up to temperatures of 600 C. Both a loss of strength, as well as plastic deformation of the matrix occurs at approximately 700 C. If cross flow filters are manufactured from an alumina/mullite matrix that contains an approximately 30.5 wt percent amorphous content, the plastic nature of the glass phase could potentially serve as a substrate for fines collection during initial filter operation at 700 C. Similarly the plastic nature could potentially cause deformation of the filter under load. DOE

N93-21675# Los Alamos National Lab., NM.
CONDUCTING POLYMERS AS POTENTIAL ACTIVE MATERIALS IN ELECTROCHEMICAL SUPERCAPACITORS
A. Rudge, J. Davey, I. Raistrick, S. Gottesfeld, and J. P. Ferraris 1992 32 p Presented at the 2nd International Seminar on Doublie Layer-Capacitors and Similar Energy Storage Devices, Deerfield, FL, 7-9 Dec. 1992
(Contract W-7405-eng-36)
(DE93-003827; LA-UR-92-3755; CONF-921232-1) Avail: CASI HC A03/MF A01

Electronically, conducting polymers represent an interesting class of materials for use in electrochemical capacitors because of the combination of high capacitive energy density and low materials cost. Three generalized types of electrochemical capacitors can be constructed using conducting polymers as active material, and in the third of these, which utilizes conducting polymers that can be both n- and p-doped, energy densities of up to 40 watt-hours per kilogram of active material on both electrodes were demonstrated. DOE

N93-21683# Research Triangle Inst., Research Triangle Park, NC.
SURFACE-COATING-FREE MATERIALS WORKSHOP Summary Report, Dec. 1990 - Jul. 1991
Coleen M. Northeim, Mary W. Moore, and John L. Warren Aug. 1992 111 p Workshop held in San Diego, CA, 17-19 Jul. 1991 Sponsored by EPA
(Grant EPA-R-815169)
(PB93-101160; EPA/600/R-92/159) Avail: CASI HC A06/MF A02

The report documents a pollution prevention workshop that explored the concept of surface-coating-free materials (SCFM's) and the potential impact of the type of material on volatile organic compound (VOC) and air toxic emissions from surface coating operations. The report summarizes the background and methodology used in planning the workshop, discussions that took place in the brainstorming sessions, and recommendations from the workshop. Included with the report are the technical papers presented as part of the workshop. The workshop consisted of two parts: technical paper presentations and brainstorming sessions. Technical papers were presented by representatives of varied industries that currently use or are developing SCFM's. The aim of the small group brainstorming sessions was to discuss topics related to the use of SCFM's. A major objective of these sessions was to identify and develop prevention research concepts and recommendations for consideration by EPA that could expand the use of SCFM's. GRA

N93-21708# Plaur Corp., Philadelphia, PA.
THE XU-TEC PROCESS OF INTRODUCING NORMALLY SOLID MATERIALS INTO SUBSTRATE SURFACES
Zhong Xu 21 Dec. 1992 8 p
(Contract DE-FG01-92CE-15503)
(DE93-005124; DOE/CE-15503/T2) Avail: CASI HC A02/MF A01

Most of the initial alloying work was with the interior of pipe segments. The source electrode, an Inconel 625 rod, was inserted into carbon steel pipe segment cathode. Alloy layers were deposited on the interior surfaces of these segments; maximum thickness of 8 microns was obtained for a potential difference of 200 V. DOE

N93-21722# IIT Research Inst., Bartlesville, OK. National Inst. for Petroleum and Energy Research.
THE EFFECT OF LAMINATION ANGLE ON POLYMER RETENTION
H. W. Gao Sep. 1992 16 p
(Contract DE-FC22-83FE-60149)
(DE93-004304; NIPER-630) Avail: CASI HC A03/MF A01

Polymer retention may be affected by the reservoir geological structure due to lamination of the mineral surfaces. These laminae are very prevalent in Class 1 reservoirs. To account for the effect of lamination angle on polymer retention, several corefloods with three fired, rectangular, Berea sandstone cores were conducted. The three cores were cut at three different angles, 0, 30, and 90 degrees, with respect to the direction of laminations. A multiple slug retention method was used to determine the retention of a biopolymer in each core. Tracer tests were conducted before and after the biopolymer flow to determine how the retained biopolymer affected the fluid advance. A computed tomography (CT) scanning method was used to monitor the advance of the tracer. All corefloods and tracer tests were conducted at low flow rates similar to that in reservoirs. Coreflood tests revealed that polymer retention, which was mainly caused by mechanical entrapment, was higher in cores that had laminations parallel to the direction of flow than in cores that had crossbed laminae. In cores that had crossbed laminae, polymer retention increased with an increase in the lamination angle. Retained polymer is harmful to the stability of fluid front in cores that have laminations parallel to the direction of flow, but is helpful in cores that have crossbed laminae. DOE

N93-21731# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemistry.
CATIONICALLY POLYMERIZABLE MONOMERS DERIVED FROM RENEWABLE SOURCES
J. V. Crivello 1 Oct. 1992 14 p
(Contract DE-FG02-91ER-12117)
(DE93-005926; DOE/ER-12117/2) Avail: CASI HC A03/MF A01

The objectives of this project are to design and synthesize novel monomers which originate from renewable biological sources and to carry out their rapid, efficient, pollution-free, and energy efficient cationic polymerization to useful products under the influence of ultraviolet light or heat. A summary of the results of the past year's research on cationically polymerizable monomers derived from renewable sources is presented. Three major areas of investigation corresponding to the different classes of naturally occurring starting materials were investigated: epoxidized terpenes and natural rubber and vinyl ethers from alcohols and carbohydrates. DOE

N93-21765# Midwest Research Inst., Golden, CO.
CURRENT STATUS, RESEARCH NEEDS, AND OPPORTUNITIES IN APPLICATIONS OF SURFACE PROCESSING TO TRANSPORTATION AND UTILITIES TECHNOLOGIES
A. W. Czanderna, ed. and A. R. Landgrebe, ed. Sep. 1992 426 p Workshop held in Washington, DC, 10-12 Dec. 1991
(Contract DE-AC02-83CH-10093)
(DE92-016446; NREL/CP-412-5007; CONF-9112112) Avail: CASI HC A19/MF A04

The goal of surface processing is to develop innovative methods of surface modification and characterization for optimum performance and environmental protection for cost-effective operational lifetimes of systems, materials, and components used in transportation and utilities. These proceedings document the principal discussions and conclusions reached at the workshop; they document chapters about the current status of surface characterization with focus on composition, structure, bonding, and atomic-scale topography of surfaces. Also documented are chapters on the current status of surface modification techniques: electrochemical, plasma-aided, reactive and nonreactive physical vapor deposition, sol-gel coatings, high-energy ion implantation, ion-assisted deposition, organized molecular assemblies, and solar energy. Brief chapters in the appendices document basic research in surface science by NSF, Air Force, and DOE. Participants at the workshop were invited to serve on 10 working groups. Separate abstracts were prepared for the data base where appropriate. DOE

N93-21817# Minnesota Mining and Mfg. Co., Saint Paul. New Products Dept.

ADVANCED CERAMIC COMPONENT DEVELOPMENT FOR HIGH TEMPERATURE INDIRECT GAS-FIRED HEATING SYSTEMS Final Report, Feb. 1988 - Sep. 1991, and Annual Report, Jun. 1990 - Sep. 1991

Robert S. Kirk Oct. 1992 52 p Sponsored by Gas Research Inst., Chicago, IL

(Contract GRI-5087-238-1606)

(PB93-127033; GRI-92/0032) Avail: CASI HC A04/MF A01

The CVD silicon carbide process was developed to a point were it can reproducibly deposit material within, around, and along the length of tubes, either individually or in multiples. Two methods for sealing the tubes were worked out: one procedure involved a modification of the CVD process, while the other used a sealant coating after the CVD of the silicon carbide. Twenty-three radiant burner tubes, 3 inches in diameter and 62-1/2 inches long, were made, one at a time. The tubes were made for the Caterpillar field test. The permeabilities of the tubes met the requirements of the furnace at Caterpillar. After eighteen months of operation in the field test of Nextel(TM) 312 Siconex, three tubes failed through the degradation of silicon carbide and one was broken in handling. A total of 17 tubes were tested. Installing the Siconex(TM) Corebusters reduced the energy usage by 22 to 25 percent. A total of six full-sized (8 inch x 94 inch) radiant burner tubes incorporating the high temperature fiber Nextel(TM) 440, were coated with silicon carbide. One full-sized 440 tube was painted with a refractory coating and tested at Columbia Gas. Aside from the painted coating flaking off, the tube was able to take the worst that Columbia could give it. Two more full-sized tubes utilizing Nextel(TM) 440 were sealed in the CVD coating process and installed in the pusher forge at SIFCO. GRA

N93-21829# Department of the Navy, Washington, DC.

LOW LOSS GLASS AND OPTICAL FIBERS THEREFROM Patent Application

Paige L. Higby, inventor (to Navy), Ishwar D. Aggarwal, inventor (to Navy), and E. J. Frievele, inventor (to Navy) 3 Aug. 1992 20 p

(AD-D015567; US-Patent-Appl-SN-923450; Navy-Case-73520) Avail: CASI HC A03/MF A01

Optical fibers and glass composition comprising a mixture of barium oxide, gallium oxide, germanium oxide, and a modifying agent selected from lanthium oxide, indium oxide, and mixtures thereof are presented. The molar ratio of barium oxide to gallium oxide is from about 4:1 to about 1:1, preferably 2:1 TO 1, and especially about 1:1. The amount of germanium oxide is at least 40 mole percent, preferably 60 to 95 mole percent, and especially 65 to 90 mole percent; about 0.1 to about 5 mole percent, preferably 0.5 to 4, of gallium oxide is replaced with the modifying agent. The optical fibers made from the glass composition defined herein, with or without the modifying agent, have light transmission wavelength band of about 0.3 to 4 microns; lower optical loss than silica-based optical fibers with the minimum optical loss of the novel fibers having the potential of 0.05 dB/km at 2 microns. GRA

N93-21843# Oak Ridge National Lab., TN.

APPLICATIONS OF NEURAL NETWORKS IN POLYMER SIMULATIONS

D. W. Noid, J. A. Darsey (Arkansas Univ., Fayetteville.), and B. G. Sumpter 1992 12 p Presented at the Society of Plastic Engineers Meeting, New Orleans, LA, 22-26 Mar. 1993

(Contract DE-AC05-84OR-21400)

(DE93-004110; CONF-930373-1) Avail: CASI HC A03/MF A01

The simulation of polymer properties and dynamics has always represented a grand challenge for current computers. The reasons for this are twofold: (1) to have the unique properties of polymers involves the molecular bonding of thousands of atoms; and (2) the time scale of interest for most polymer processes is quite long relative to the vibrational periods. Current work on polymer dynamics in our laboratory consists of molecular dynamics simulations of systems with greater than 10,000 atoms which requires extensive computer calculations on supercomputers. A large effort is needed to make these calculations and even more realistic simulations (with larger systems) feasible. One approach is to develop methods which can be mapped on new parallel computers such as Kendall Square, Hypercube, Connection machine, etc. Another approach is to develop new methodologies which can supplement current molecular dynamics simulations. For the past few years, new techniques for polymer dynamics were formulated. Some of this work has involved utilizing new spectral methods, geometric statement functions, and more recently neural networks. Results and simulations obtained by combining neural networks with molecular dynamics simulations are discussed. DOE

N93-21853# Argonne National Lab., IL.

EROSION OF COMPOSITE CERAMICS

J. L. Routbort Aug. 1992 19 p Presented at the 8th International Symposium on Ceramics and 2nd National Conference on Advanced Ceramics and Exhibition on New Ceramic Materials, Rimini, Italy, 9-13 Nov. 1992

(Contract W-31-109-eng-38)

(DE93-004254; ANL/CP-75338; CONF-921147-1) Avail: CASI HC A03/MF A01

The theoretical basis to describe solid-particle erosion of monolithic ceramics is well developed. In many cases, the models can account for the impact velocity, impact angle, and erodent-size dependencies of the steady-state erosion rate. In addition, the models account for effects of materials parameters such as fracture toughness and hardness. Steady-state erosion measurements on a wide variety of composite ceramics, including SiC whisker-reinforced Al2O3, Si3N4 containing Si3N4 or SiC whiskers, Y2O3-stabilized ZrO2 reinforced with SiC whiskers, and duplex-microstructure Si3N4 have been reported. The theories developed for monolithic ceramics are, however, less successful in describing the results for composites. DOE

N93-20188*# National Inst. of Standards and Technology, Gaithersburg, MD. Chemical Science and Technology Lab.

PRINCIPLES OF GAS PHASE PROCESSING OF CERAMICS DURING COMBUSTION

Michael R. Zachariah *In* NASA, Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 81-87 (For primary document see N93-20178 07-29)

Avail: CASI HC A02/MF A03; 11 functional color pages

N93-20475# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.

SURVEY AND REVIEW ON ADHESIVES [SECCHAKUZAI NO CHOUSA KENTOU]

Tadaaki Kurosaki and Takashi Watanabe *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 279-283 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

N93-20627# Toronto Univ. (Ontario). Dept. of Metallurgy and Materials Science.

ADVANCED STRUCTURAL CERAMICS

T. W. Coyle *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 114-115 (For primary document see N93-20616 07-39)

Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20639# Ecole Polytechnique, Montreal (Quebec).

CREEP DAMAGE OF CARBON FIBER REINFORCED PEEK [ENDOMMAGEMENT EN FLUAGE DU PEEK RENFORCE PAR DES FIBRES DE CARBONE]

H. Ould Brahim, T. Vu Khanh, and R. Gauvin *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 188-189 In FRENCH (For primary document see N93-20616 07-39)

Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20812# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

PROTECTION OF COMPOSITE MATERIALS IN SPACE. THE LDEF EXPERIENCE

R. C. Tennyson *In* Canadian Space Agency, Protection of Materials and Surface Finishes from the Low Earth Orbit Space Environment 1992 26 p (For primary document see N93-20810 07-25)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3, HC

N93-20813*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ISSUES/CONSIDERATIONS AND PERFORMANCE PREDICTION OF LEO PROTECTIVE COATINGS
Bruce A. Banks *In* Canadian Space Agency, Protection of Materials and Surface Finishes from the Low Earth Orbit Space Environment 1992 83 p (For primary document see N93-20810 07-25)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3, HC

N93-20816# Boeing Defense and Space Group, Seattle, WA.
SPACE STATION PROTECTIVE COATING DEVELOPMENT
Gary Pippin *In* Canadian Space Agency, Protection of Materials and Surface Finishes from the Low Earth Orbit Space Environment 1992 48 p (For primary document see N93-20810 07-25)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3, HC

N93-20818# Spar Aerospace Ltd., Brampton (Ontario).
LEO RESISTANT THERMAL CONTROL MATERIALS AND DRY LUBRICANTS FOR THE MOBILE SERVICING SYSTEM
S.-K. Chang *In* Canadian Space Agency, Protection of Materials and Surface Finishes from the Low Earth Orbit Space Environment 1992 38 p (For primary document see N93-20810 07-25)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3, HC

N93-20819# FRE Composites, Inc., Saint Andre-Est (Quebec).
PROTECTION OF RADARSAT SAR ANTENNA GRAPHITE/EPOXY SUPPORT STRUCTURE
E. Calius and P. Vallee *In* Canadian Space Agency, Protection of Materials and Surface Finishes from the Low Earth Orbit Space Environment 1992 21 p (For primary document see N93-20810 07-25)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3, HC

N93-20820# McDonnell-Douglas Space Systems Co., Huntington Beach, CA.
PROTECTIVE COATING DEVELOPMENT FOR SPACE STATION FREEDOM AT MCDONNELL DOUGLAS
Henry W. Babel *In* Canadian Space Agency, Protection of Materials and Surface Finishes from the Low Earth Orbit Space Environment 1992 35 p (For primary document see N93-20810 07-25)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3, HC

N93-20821# Sheldahl Co., Northfield, MN.
ATOMIC OXYGEN RESISTANT SiOx COATED KAPTON FOR SPACE STATION FREEDOM, AND ALTERNATE COATINGS
Alan Freeland, Jeffrey Fink, Gary Meinke, James Grieser, Marge Berendt, and Hiroshi Takeo (Lockheed Missiles and Space Co., Sunnyvale, CA.) *In* Canadian Space Agency, Protection of Materials and Surface Finishes from the Low Earth Orbit Space Environment 1992 19 p (For primary document see N93-20810 07-25)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3, HC

N93-20822# Ecole Polytechnique, Montreal (Quebec). Dept. of Engineering Physics.
MULTIPURPOSE PROTECTIVE COATINGS FOR SPACECRAFT APPLICATIONS
M. R. Wertheimer *In* Canadian Space Agency, Protection of Materials and Surface Finishes from the Low Earth Orbit Space Environment 1992 23 p (For primary document see N93-20810 07-25)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3, HC

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N93-20132*# National Aeronautics and Space Administration. John C. Stennis Space Center, Bay Saint Louis, MS.
THE FIRST NASA AEROSPACE PYROTECHNIC SYSTEMS WORKSHOP
William W. St.Cyr, comp. Washington Jan. 1993 417 p Workshop held in Houston, TX, 9-10 Jun. 1992
(NASA-CP-3169; NAS 1.55:3169) Avail: CASI HC A18/MF A04

Papers from the conference proceedings are presented, and they are grouped by the following sessions: pyrotechnically actuated systems, laser initiation, and modeling and analysis. A fourth session, a panel discussion and open forum, concluded the workshop. For individual titles, see N93-20133 through N93-20153.

N93-20133*# National Aeronautics and Space Administration, Washington, DC.
NASA PYROTECHNICALLY ACTUATED SYSTEMS PROGRAM
Norman R. Schulze *In* NASA. Stennis Space Center, The First NASA Aerospace Pyrotechnic Systems Workshop Jan. 1993 p 1-31 (For primary document see N93-20132 07-28)
Avail: CASI HC A03/MF A04

The Office of Safety and Mission Quality initiated a Pyrotechnically Actuated Systems (PAS) Program in FY-92 to address problems experienced with pyrotechnically actuated systems and devices used both on the ground and in flight. The PAS Program will provide the technical basis for NASA's projects to incorporate new technological developments in operational systems. The program will accomplish that objective by developing/testing current and new hardware designs for flight applications and by providing a pyrotechnic data base. This marks the first applied pyrotechnic technology program funded by NASA to address pyrotechnic issues. The PAS Program has been structured to address the results of a survey of pyrotechnic device and system problems with the goal of alleviating or minimizing their risks. Major program initiatives include the development of a Laser Initiated Ordnance System, a pyrotechnic systems data base, NASA Standard Initiator model, a NASA Standard Linear Separation System and a NASA Standard Gas Generator. The PAS Program sponsors annual aerospace pyrotechnic systems workshops. Author

N93-20134*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DETERMINATION OF PYROTECHNIC FUNCTIONAL MARGIN
Laurence J. Bement and Morry L. Schimmel (Schimmel Co., Saint Louis, MO.) *In* NASA. Stennis Space Center, The First NASA Aerospace Pyrotechnic Systems Workshop Jan. 1993 p 34-50 (For primary document see N93-20132 07-28)
Avail: CASI HC A03/MF A04

Following the failure of a previously qualified pyrotechnically actuated pin puller design, an investigation led to a redesign and requalification. The emphasis of the second qualification was placed on determining the functional margin of the pin puller by comparing the energy deliverable by the pyrotechnic cartridge to the energy required to accomplish the function. Also determined were the effects of functional variables. This paper describes the failure investigation, the test methods employed and the results of the evaluation, and provides a recommended approach to assure the successful functioning of pyrotechnic devices. Derived from text

N93-20135*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
DEVELOPMENT OF A NASA STANDARD GAS GENERATOR
Laurence J. Bement, Harold Karp (Hi-Shear Corp., Torrance, CA.), and Morry L. Schimmel (Schimmel Co., Saint Louis, MO.) *In* NASA. Stennis Space Center, The First NASA Aerospace Pyrotechnic Systems Workshop Jan. 1993 p 51-82 (For primary document see N93-20132 07-28)
Avail: CASI HC A03/MF A04

The goals of the NASA Standard Gas Generator (NSGG) Program are to create a NASA standard gas generating cartridge, characterize its

performance, and make it readily available to users. A cartridge within the same envelope as the NASA Standard Initiator (NSI) has the greatest potential use. This potential use is described in viewgraph form. Our approach for NSGG development and qualification was planned to be conducted in several phases. Test methods were developed to evaluate output performance for a variety of potential applications. A feasibility study using modified NSI's was accomplished. Preliminary and final development will be conducted with a delta qualification to evaluate the effects of manufacturing lots and environments. Feasibility study results, feasibility study conclusions, and future plans are presented. Derived from text

N93-20136*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PYROTECHNICALLY ACTUATED SYSTEMS DATABASE AND APPLICATIONS CATALOG
Paul Steffes (Analex Corp., Cleveland, OH.) *In* NASA. Stennis Space Center, The First NASA Aerospace Pyrotechnic Systems Workshop Jan. 1993 p 83-92 (For primary document see N93-20132 07-28)
Avail: CASI HC A02/MF A04

The topics are presented in viewgraph form and include the following: the purpose of the database and catalog; implementation ground rules; database menu format; and deliverables. Derived from text

N93-20137*# Sandia National Labs., Albuquerque, NM. Explosive Components Dept.
A SEMICONDUCTOR BRIDGE IGNITED HOT GAS PISTON EJECTOR
M. C. Grubelich and Robert W. Bickes, Jr. *In* NASA. Stennis Space Center, The First NASA Aerospace Pyrotechnic Systems Workshop Jan. 1993 p 93-121 (For primary document see N93-20132 07-28)
Avail: CASI HC A03/MF A04

The topics are presented in viewgraph form and include the following: semiconductor bridge technology (SCB); SCB philosophy; technology transfer; simplified sketch of SCB; SCB processing; SCB design; SCB test assembly; 5 mJ SCB burst based on a polaroid photograph; micro-convective heat transfer hypothesis; SCB fire set; comparison of SCB and hot-wire actuators; satellite firing sets; logic fire set; SCB smart component; SCB smart firing set; semiconductor design considerations; and the adjustable actuator system. Derived from text

N93-20138*# Santa Barbara Research Center, Goleta, CA.
SMALL ICBM LASER FIRING UNIT (LFU)
Jim Aloise and Larry Snarr *In* NASA. Stennis Space Center, The First NASA Aerospace Pyrotechnic Systems Workshop Jan. 1993 p 123-136 (For primary document see N93-20132 07-28)
Avail: CASI HC A03/MF A04

The topics are presented in viewgraph form and include the following: history/schedule, LFU development hardware; specifications/features; components; optical layout-arm; optical layout-safe; built in test; and producibility issues. Derived from text

N93-20139*# McDonnell-Douglas Missile Systems Co., Saint Louis, MO.
LASER-INITIATED ORDNANCE FOR AIR-TO-AIR MISSILES
David R. Sumpter *In* NASA. Stennis Space Center, The First NASA Aerospace Pyrotechnic Systems Workshop Jan. 1993 p 137-147 (For primary document see N93-20132 07-28)
Avail: CASI HC A03/MF A04

McDonnell Douglas Missile Systems Company (MDMSC) has developed a laser ignition subsystem (LIS) for air-to-air missile applications. The MDMSC subsystem is designed to activate batteries, unlock fins, and sequence propulsion system events. The subsystem includes Pyro Zirconium Pump (PZP) lasers, mechanical Safe & Arm, fiber-optic distribution system, and optically activated pyrotechnic devices (initiators, detonators, and thermal batteries). The LIS design has incorporated testability features for the laser modules, drive electronics, fiber-optics, and pyrotechnics. Several of the LIS have been fabricated and have supported thermal battery testing, integral rocket ramjet testing, and have been integrated into integral rocket ramjet flight test vehicles as part of the flight control subsystem. Author

N93-20140*# Ensign Bickford Aerospace Co., Simsbury, CT.
LASER DIODE ORDNANCE DESIGN
Arthur D. Rhea *In* NASA. Stennis Space Center, The First NASA Aerospace Pyrotechnic Systems Workshop Jan. 1993 p 149-156 (For primary document see N93-20132 07-28)
Avail: CASI HC A02/MF A04

The topics are presented in viewgraph form and include the following: characteristics, system description, laser firing unit, fiber optic cables, and initiators. Derived from text

N93-20141*# Aerojet Strategic Propulsion Co., Sacramento, CA. Advanced Solid Rocket Motor Div.
INTRODUCTION OF LASER INITIATION FOR THE 48-INCH ADVANCED SOLID ROCKET MOTOR (ASRM) TEST MOTORS AT MARSHALL SPACE FLIGHT CENTER (MSFC) **c20**
Chris J. Zimmerman and Gerald E. Litzinger *In* NASA. Stennis Space Center, The First NASA Aerospace Pyrotechnic Systems Workshop Jan. 1993 p 157-177 (For primary document see N93-20132 07-28)
Avail: CASI HC A03/MF A04

The Advanced Solid Rocket Motor is a new design for the Space Shuttle Solid Rocket Booster. The new design will provide more thrust and more payload capability, as well as incorporating many design improvements in all facets of the design and manufacturing process. A 48-inch (diameter) test motor program is part of the ASRM development program. This program has multiple purposes for testing of propellent, insulation, nozzle characteristics, etc. An overview of the evolution of the 48-inch ASRM test motor ignition system which culminated with the implementation of a laser ignition system is presented. The laser system requirements, development, and operation configuration are reviewed in detail. Derived from text

N93-20142*# Sandia National Labs., Albuquerque, NM.
LASER DIODE IGNITION ACTIVITIES AT SANDIA NATIONAL LABORATORIES
John A. Merson, F. Jim Salas, Weng W. Chow, J. W. Clements, and William J. Kass *In* NASA. Stennis Space Center, The First NASA Aerospace Pyrotechnic Systems Workshop Jan. 1993 p 179-196 (For primary document see N93-20132 07-28)
Avail: CASI HC A03/MF A04

The topics are presented in viewgraph form and include the following: ignition subsystems, enhanced safety, optical ordnance power densities, optical ignition factors, low energy optical ordnance program, absorptance of 2-(5-cyanotetrazolato) pentaaminecobalt(III) perchlorate (CP) near 800 nm, power dependence of doped CP, system operational electrical requirements, dopant concentration effects for different CP particle sizes, ZR/KCLO4 optical ignition thresholds, and electrostatic discharge testing. Derived from text

N93-20143*# Sandia National Labs., Albuquerque, NM. Advanced Weapon Systems Dept.
LASER-BASED FIRING SYSTEMS FOR PROMPT INITIATION OF SECONDARY EXPLOSIVES Abstract Only
Kent D. Meeks and Robert E. Setchell *In* NASA. Stennis Space Center, The First NASA Aerospace Pyrotechnic Systems Workshop Jan. 1993 p 197-198 (For primary document see N93-20132 07-28)
Avail: CASI HC A01/MF A04

Motivated by issues of weapon safety and security, laser based firing systems for promptly initiating secondary explosives have been under active development at Sandia National Laboratories for more than four years. Such a firing system consists of miniaturized, Q-switched, solid-state laser, optical detonators, optical safety switches, and elements for splitting, coupling, and transmitting the laser output. Potential system applications pose significant challenges in terms of server mechanical and thermal environments and packaging constraints, while requiring clear demonstration of safety enhancements. The Direct Optical Initiation (DOI) Program at Sandia is addressing these challenges through progress development phases during which the design, fabrication, and testing of prototype hardware is aimed at more difficult application requirements. A brief history of the development program, and a summary of current and planned activities, will be presented. Author (revised)

N93-20144*# McDonnell-Douglas Electronics Co., Saint Louis, MO.
PROPOSED SYSTEM SAFETY DESIGN AND TEST REQUIREMENTS FOR THE MICROLASER ORDNANCE SYSTEM
Barb A. Stoltz and Dale F. Waldo *In* NASA. Stennis Space Center, The

First NASA Aerospace Pyrotechnic Systems Workshop Jan. 1993 p 203-214 (For primary document see N93-20132 07-28)
Avail: CASI HC A03/MF A04

Safety for pyrotechnic ignition systems is becoming a major concern for the military. In the past twenty years, stray electromagnetic fields have steadily increased during peacetime training missions and have dramatically increased during battlefield missions. Almost all of the ordnance systems in use today depend on an electrical bridgewire for ignition. Unfortunately, the bridgewire is the cause of the majority of failure modes. The common failure modes include the following: broken bridgewires; transient RF power, which induces bridgewire heating; and cold temperatures, which contracts the explosive mix away from the bridgewire. Finding solutions for these failure modes is driving the costs of pyrotechnic systems up. For example, analyses are performed to verify that the system in the environment will not see more energy than 20 dB below the 'No-fire' level. Range surveys are performed to determine the operational, storage, and transportation RF environments. Cryogenic tests are performed to verify the bridgewire to mix interface. System requirements call for 'last minute installation,' 'continuity checks after installation,' and rotating safety devices to 'interrupt the explosive train.' As an alternative, MDESC has developed a new approach based upon our enabling laser diode technology. We believe that Microlaser initiated ordnance offers a unique solution to the bridgewire safety concerns. For this presentation, we will address, from a system safety viewpoint, the safety design and the test requirements for a Microlaser ordnance system. We will also review how this system could be compliant to MIL-STD-1576 and DOD-83578A and the additional necessary requirements. Author (revised)

N93-20145*# Hi-Shear Corp., Torrance, CA.
LASER DIODE IGNITION CHARACTERISTICS OF ZIRCONIUM POTASSIUM PERCHLORATE (ZPP)
Jerry D. Callaghan and Scot Tindol *In* NASA. Stennis Space Center, The First NASA Aerospace Pyrotechnic Systems Workshop Jan. 1993 p 215-222 (For primary document see N93-20132 07-28)
Avail: CASI HC A02/MF A04

Hi-Shear Technology, Corp., (HSTC) has designed and built a Laser equivalent NASA Standard Initiator (LNSI). Langlie tests with a laser diode output initiating ZPP were conducted as a part of this effort. The test parameters include time to first pressure, laser power density requirements, and ignition time. The data from these laser tests on ZPP are presented. Author (revised)

N93-20146*# Spectra Diode Labs., San Jose, CA.
ADVANCES IN LASER DIODES FOR PYROTECHNIC APPLICATIONS
Richard R. Craig *In* NASA. Stennis Space Center, The First NASA Aerospace Pyrotechnic Systems Workshop Jan. 1993 p 223-245 (For primary document see N93-20132 07-28)
Avail: CASI HC A03/MF A04

Background information concerning the use of laser diodes in pyrotechnic applications is provided in viewgraph form. The following topics are discussed: damage limits, temperature stability, fiber coupling issues, and small (100 micron) and large (400 micron) fiber results. The discussions concerning fiber results concentrate on the areas of package geometry and electro-optical properties. CASI

N93-20147*# Ensign Bickford Aerospace Co., Simsbury, CT.
LASER DIODE INITIATED DETONATORS FOR SPACE APPLICATIONS
David W. Ewick, J. A. Graham, and J. D. Hawley *In* NASA. Stennis Space Center, The First NASA Aerospace Pyrotechnic Systems Workshop Jan. 1993 p 247-256 (For primary document see N93-20132 07-28)
Avail: CASI HC A02/MF A04

Ensign Bickford Aerospace Company (EBAC) has over ten years of experience in the design and development of laser ordnance systems. Recent efforts have focused on the development of laser diode ordnance systems for space applications. Because the laser initiated detonators contain only insensitive secondary explosives, a high degree of system safety is achieved. Typical performance characteristics of a laser diode initiated detonator are described in this paper, including all-fire level, function time, and output. A finite difference model used at EBAC to predict detonator performance, is described and calculated results are compared to experimental data. Finally, the use of statistically designed experiments to evaluate performance of laser initiated detonators is discussed. Author

N93-20148*# Sandia National Labs., Albuquerque, NM.
PORTABLE FIBER OPTIC COUPLED DOPPLER INTERFEROMETER SYSTEM FOR DETONATION AND SHOCK WAVE DIAGNOSTICS c35
Kevin J. Fleming *In* NASA. Stennis Space Center, The First NASA Aerospace Pyrotechnic Systems Workshop Jan. 1993 p 257-273 (For primary document see N93-20132 07-28)
(SAND-92-1359C) Avail: CASI HC A03/MF A04

Testing and analysis of shock wave characteristics such as detonators and ground shock propagation frequently require a method of measuring velocity and displacement of the surface of interest. One method of measurement is Doppler interferometry. The VISAR (Velocity Interferometer System for Any Reflector) uses Doppler interferometry and has gained wide acceptance as the preferred tool for shock measurement. An important asset of VISAR is that it measures velocity and displacement nonintrusively. Author

N93-20149*# EG and G Mound Applied Technologies, Miamisburg, OH.
DEVELOPMENT AND TESTING OF HERMETIC, LASER-IGNITED PYROTECHNIC AND EXPLOSIVE COMPONENTS
Daniel P. Kramer, Thomas M. Beckman, Ed M. Spangler, Alan C. Munger, and C. M. Woods *In* NASA. Stennis Space Center, The First NASA Aerospace Pyrotechnic Systems Workshop Jan. 1993 p 275-285 (For primary document see N93-20132 07-28)
(Contract DE-AC04-88DP-43495)
Avail: CASI HC A03/MF A04

During the last decade there has been increasing interest in the use of lasers in place of electrical systems to ignite various pyrotechnic and explosive materials. The principal driving force for this work was the requirement for safer energetic components which would be insensitive to electrostatic and electromagnetic radiation. In the last few years this research has accelerated since the basic concepts have proven viable. At the present time it is appropriate to shift the research emphasis in laser initiation from the scientific arena--whether it can be done--to the engineering realm--how it can be put into actual practice in the field. Laser initiation research and development at EG&G Mound was in three principal areas: (1) laser/energetic material interactions; (2) development of novel processing techniques for fabricating hermetic (helium leak rate of less than 1 x 10(exp -8) cu cm/s) laser components; and (3) evaluation and testing of laser-ignited components. Research in these three areas has resulted in the development of high quality, hermetic, laser initiated components. Examples are presented which demonstrate the practicality of fabricating hermetic, laser initiated explosive or pyrotechnic components that can be used in the next generation of ignitors, actuators, and detonators. Author (revised)

N93-20150*# Aerospace Corp., Los Angeles, CA.
APPLICATION OF THE MESA REACTIVE HYDROCODE TO SPACE VEHICLE EXPLOSIVE ORDNANCE DEVICES
Selma Goldstein *In* NASA. Stennis Space Center, The First NASA Aerospace Pyrotechnic Systems Workshop Jan. 1993 p 287-328 (For primary document see N93-20132 07-28)
Avail: CASI HC A03/MF A04

The construction of detailed computational models of the dynamic behavior of various explosive ordnance devices used on space vehicles is discussed. The following topics are presented in viewgraph form: numerical methods, explosives and detonations, and the MESA computer code. CASI

N93-20151*# Sandia National Labs., Albuquerque, NM. Explosive Components Dept.
PRECISION LINEAR SHAPED CHARGE SEVERANCE OF GRAPHITE-EPOXY MATERIALS
Manuel G. Vigil *In* NASA. Stennis Space Center, The First NASA Aerospace Pyrotechnic Systems Workshop Jan. 1993 p 329-374 (For primary document see N93-20132 07-28)
(SAND-92-0610C) Avail: CASI HC A03/MF A04

This paper presents Precision Linear Shaped Charge (PLSC) components designed to sever a variety of target materials. Recent data for the severance of graphite-epoxy panels or targets with PLSC's are presented. A brief history of the requirement to originate the development of PLSC's for weapon components at Sandia National Laboratories is presented. The Department of Energy's (DOE) nuclear weapon systems have continually

decreased in size. Today's relatively small weapons require the design of much more efficient, lighter, and smaller explosive components because fragments, air shocks, and pyro-shocks associated with the function of these components can damage electrical and other sensitive components located nearby. The DOE requirements for PLSC's are listed. Therefore, linear shaped charge (LSC) components for weapon systems can no longer be empirically or experimentally designed for a given application. Many of today's designs require severing concentric cylinders, for example, where the LSC jet is designed to sever only one of the two cylinders as was the case for the B90/Nuclear Depth Strike Bomb. Therefore, code modeling and simulation technology must be utilized to obtain a better understanding of the LSC jet hydrodynamic penetration, fracture, shear, and spall mechanisms associated with the severance of metallic as well as composite targets. Author (revised)

N93-20152*# Sandia National Labs., Albuquerque, NM. Explosive Projects and Diagnostics.

EXPLOSIVE COMPONENT ACCEPTANCE TESTER USING LASER INTERFEROMETER TECHNOLOGY **c35**

Richard D. Wickstrom and William W. Tarbell *In* NASA. Stennis Space Center, The First NASA Aerospace Pyrotechnic Systems Workshop Jan. 1993 p 375-395 (For primary document see N93-20132 07-28)
(SAND-92-0324C) Avail: CASI HC A03/MF A04

Acceptance testing of explosive components requires a reliable and simple to use testing method that can discern less than optimal performance. For hot-wire detonators, traditional techniques use dent blocks or photographic diagnostic methods. More complicated approaches are avoided because of their inherent problems with setup and maintenance. A recently developed tester is based on using a laser interferometer to measure the velocity of flying plates accelerated by explosively actuated detonators. Unlike ordinary interferometers that monitor displacement of the test article, this device measures velocity directly and is commonly used with non-spectral surfaces. Most often referred to as the VISAR technique (Velocity Interferometer System for Any Reflecting Surface), it has become the most widely-accepted choice for accurate measurement of velocity in the range greater than 1 mm/micro-s. Traditional VISAR devices require extensive setup and adjustment and therefore are unacceptable in a production-testing environment. This paper describes a new VISAR approach which requires virtually no adjustments, yet provides data with accuracy comparable to the more complicated systems. The device, termed the Fixed-Cavity VISAR, is currently being developed to serve as a product verification tool for hot-wire detonators and slappers. An extensive data acquisition and analysis computer code was also created to automate the manipulation of raw data into final results. Author (revised)

N93-20153*# Notre Dame Univ., IN. Dept. of Aerospace and Mechanical Engineering.

PYROTECHNIC MODELING FOR THE NSI AND PIN PULLER

Joseph M. Powers and Keith A. Gonthier *In* NASA. Stennis Space Center, The First NASA Aerospace Pyrotechnic Systems Workshop Jan. 1993 p 397-412 (For primary document see N93-20132 07-28)
(Grant NAG3-1335)
Avail: CASI HC A03/MF A04

A discussion concerning the modeling of pyrotechnically driven actuators is presented in viewgraph format. The following topics are discussed: literature search, constitutive data for full-scale model, simple deterministic model, observed phenomena, and results from simple model. CASI

N93-20231*# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.

IGNITION AND COMBUSTION CHARACTERISTICS OF METALLIZED PROPELLANTS Semiannual Report, Jan. - Jun. 1991

D. C. Mueller and Stephen R. Turns Jun. 1991 47 p
(Grant NAG3-1044)
(NASA-CR-192231; NAS 1.26:192231; TR-91-008) Avail: CASI HC A03/MF A01

Over the past six months, experimental investigations were continued and theoretical work on the secondary atomization process was begun. Final shakedown of the sizing/velocity measuring system was completed and the aluminum combustion detection system was modified and tested. Atomizer operation was improved to allow steady state operation over long periods of time for several slurries. To validate the theoretical modeling, work involving carbon slurry atomization and combustion was begun and qualitative observations were made. Simultaneous measurements of aluminum slurry droplet size distributions and detection of burning aluminum particles were performed at several axial locations above the burner. The principle theoretical effort was the application of a rigid shell formation model to aluminum slurries and an investigation of the effects of various parameters on the shell formation process. This shell formation model was extended to include the process leading up to droplet disruption, and previously developed analytical models were applied to yield theoretical aluminum agglomerate ignition and combustion times. The several theoretical times were compared with the experimental results. Author

N93-20247# Department of the Navy, Washington, DC.

INTERFEROMETRIC JFTOT TUBE DEPOSIT MEASURING DEVICE Patent Application

Robert E. Morris, inventor (to Navy) and Robert Wagner, inventor (to Navy) 30 Jun. 1992 27 p
(AD-D015599; US-Patent-Appl-SN-906903; Navy-Case-73567) Avail: CASI HC A03/MF A01

Jet fuels are tested for thermal stability by passing the fuel over a heated metal tube and measuring the amount of residue deposited as a film on the tube as a result of chemical changes to the fuel. The thickness distribution and volume of a deposited film on a tube are calculated by scanning the length of the tube with an optical probe, shining light onto the tube, measuring the intensity of reflected light of a preselected wavelength from the tube, and correlating the reflected light intensity with positions on the tube. The tube is then partially rotated, and the process is repeated until the entire surface of the tube is scanned. The volumes of each longitudinal slice of the tube are summed to give the total deposit volume on the tube. GRA

N93-20588# Army Research Lab., Aberdeen Proving Ground, MD.

THERMOCHEMICAL EVALUATION OF PROPOSED ELECTROTHERMAL-CHEMICAL PROPELLANTS Final Report, Jun. - Sep. 1991

William Oberle and Eli Freedman Nov. 1992 31 p
(DA Proj. 1L1-62618-AH-80)
(AD-A259110; ARL-TR-12) Avail: CASI HC A03/MF A01

Due to the addition of electrical energy, the customary thermodynamic method of screening candidate fuels needs to be modified for application to electrothermal-chemical (ETC) systems. Instead of computing the gravimetric impetus, it is more useful to study the volumetric energy, which is defined as I*d/(gamma - 1) (I = impetus, d = density, and gamma is the ratio of the specific heats at constant pressure and constant volume). While computing the gravimetric impetus or chemical energy is nowadays a straightforward matter, estimating densities is not. A rough estimate can be obtained by assuming that volumes are additive. In addition, for a given set of ingredients, the composition with the maximum chemical energy turns out to change mildly with the amount of added electricity. Also, the density itself changes with composition. A correct computation of the maximum energy must take both effects into account. In this report, thermochemical requirements for potential ETC propellants which are required to meet weapon performance levels are identified. In addition, a procedure to the performance potential of candidate ETC propellants is proposed. This procedure is then applied to several candidate propellants. GRA

N93-21716# California State Div. of Mass Transportation, Sacramento. Div. of Mass Transportation.

PUBLIC TRANSPORTATION ALTERNATIVE FUELS: A PERSPECTIVE FOR SMALL TRANSPORTATION OPERATIONS Final Report, 1992

30 Jun. 1992 347 p Prepared in cooperation with Booze-Allen and Hamilton, Inc., Los Angeles, CA
(Contract CA-08-8018-64Q165)
(PB92-120120; FTA/DMT-CA-08-FS; CA-DMT201) Avail: CASI HC A15/MF A03

Information necessary to evaluate alternative fuels and technologies for complying with future State and Federal emission regulations is provided for small, public transportation operators in the State of California. The alternative fuels examined include 'clean diesel' fuel, methanol, nature gas (both compressed and liquefied), ethanol, and liquefied petroleum gas (LPG). These fuels are examined across a variety of criteria including fuel availability

and costs, vehicle reliability, durability, safety, fuel economy, and emission characteristics. The equipment and facilities needed for refueling alternative technology buses are also examined along with modifications needed for maintenance garages to ensure safe operations with these new fuels. All capital and operating costs associated with implementing each of the alternative fuels are detailed for different size transit properties. Advanced electric propulsion technologies including batteries, hydrogen fuel cells, and electric trolley buses are also briefly examined but in less detail than the other alternative fuels. GRA (revised)

N93-21717# California State Div. of Mass Transportation, Sacramento. Div. of Mass Transportation.
PUBLIC TRANSPORTATION ALTERNATIVE FUELS: A PERSPECTIVE FOR SMALL TRANSPORTATION OPERATIONS. EXECUTIVE SUMMARY Final Report, 1992
30 Jun. 1992 71 p Prepared in cooperation with Booz-Allen and Hamilton, Inc., Los Angeles, CA
(Contract CA-08-8018-64Q165)
(PB92-182567; FTA/DMT-CA-08-ES; CA-DMT202) Avail: CASI HC A04/MF A01

Information necessary to evaluate alternative fuels and technologies for complying with future State and Federal emission regulations is provided for small, public transportation operators in the State of California. The alternative fuels examined include 'clean diesel' fuel, methanol, natural gas (both compressed and liquefied), ethanol, and liquefied petroleum gas (LPG). These fuels are examined across a variety of criteria including fuel availability and costs, vehicle reliability, durability, safety, fuel economy, and emission characteristics. The equipment and facilities needed for refueling alternative technology buses are also examined along with modifications needed for maintenance garages to ensure safe operations with these new fuels. All capital and operating costs associates with implementing each of the alternative fuels are detailed for different size transit properties. Advanced electric propulsion technologies including batteries, hydrogen fuel cells, and electric trolley buses are also briefly examined but in less detail than the other alternative fuels. GRA (revised)

N93-21905# Sandia National Labs., Albuquerque, NM.
EXPLOSIVE VAPOR EMISSION
Bernard T. Kenna, Frank J. Conrad, and David W. Hannum *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 510-517 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

N93-21906# Ion Track Instruments, Inc., Wilmington, MA.
A THERMODYNAMIC STUDY OF THE VAPOR PRESSURES OF C-4 AND PURE RDX
William McGann, Anthony Jenkins, and K. Ribeiro *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 518-531 (For primary document see N93-21856 07-03)
(Contract DTFA03-87-C-00005)
Avail: CASI HC A03/MF A10

N93-21907# Ion Track Instruments, Inc., Wilmington, MA.
EXTRACTION, TRANSPORTATION AND PROCESSING OF EXPLOSIVES VAPOR IN DETECTION SYSTEMS
Anthony Jenkins, William McGann, and K. Ribeiro *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 532-551 (For primary document see N93-21856 07-03)
(Contract DTFA03-87-C-00005)
Avail: CASI HC A03/MF A10

N93-21908# Thermedics, Inc., Woburn, MA.
VAPOR SAMPLING USING CONTROLLED HEATING
Edward E. A. Bromberg, A. Lindsay Carroll, Freeman W. Fraim, and David P. Lieb *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 552-558 Sponsored by State Dept. (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

N93-21909# Thermedics, Inc., Woburn, MA.
EFFICIENT COLLECTION OF EXPLOSIVE VAPORS, PARTICLES AND AEROSOLS
Freeman W. Fraim, Eugene K. Achter, A. Lindsay Carroll, and Eugenie Hainsworth (Little, Arthur D., Inc., Cambridge, MA.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 559-570 Sponsored in cooperation with the State Dept. (For primary document see N93-21856 07-03)
(Contract DTRS-57-84-C)
Avail: CASI HC A03/MF A10

N93-21916# Oak Ridge National Lab., TN. Analytical Chemistry Div.
DETECTION OF EXPLOSIVES MATERIAL ON SINGLE MICROPARTICLES
W. B. Whitten, John Michael Dale, and J. M. Ramsey *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 637-641 Previously announced as N92-17962 (For primary document see N93-21856 07-03)
(Contract DE-AC05-84OR-21400)
Avail: CASI HC A01/MF A10

N93-21921# Texas A&M Univ., Galveston.
FOURIER TRANSFORM ION-CYCLOTRON RESONANCE (FT-ICR) MASS SPECTROMETRY OF RDX, PETN AND OTHER EXPLOSIVES
C. S. Giam, M. S. Ahmed, R. R. Weller, and Jennelle Derrickson *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 687-688 (For primary document see N93-21856 07-03)
Avail: CASI HC A01/MF A10

N93-21924# Scintrex Ltd., Concord (Ontario).
A GC/ECD APPROACH FOR THE DETECTION OF EXPLOSIVES AND TAGGANTS
Sabatino Nacson, Bob Mitchner, Otto Legrady, Tony Siu, and S. Nargolwalla *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 714-721 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

N93-21925# Bundeskriminalamt, Wiesbaden (Germany).
MARKING OF GERMAN PLASTIC EXPLOSIVE FOR THE ENHANCEMENT OF VAPOR DETECTION
Peter Kolla *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 723-733 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

N93-21926# Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ.
PROGRAM TO TAG MILITARY PLASTIC/SHEET EXPLOSIVES
Yukwei Sarah Eng, Joseph A. Lannon, and Carolyn Westerdahl *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 734-736 (For primary document see N93-21856 07-03)
Avail: CASI HC A01/MF A10

N93-21927# Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ.
AN IMPROVED VAPOR TAGGANT DETECTOR
Tung-Ho Chen *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 737-738 (For primary document see N93-21856 07-03)
Avail: CASI HC A01/MF A10

N93-21928# Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ.
PLANT LABORATORY SCALE PREPARATION AND COMPLETE CHARACTERIZATION OF MODIFIED COMPOSITION C-4 CONTAINING A TAGGANT
Tung-Ho Chen, C. Campbell, R. Reed, W. F. Ark, J. Autera, D. A. Wiegand, and M. S. Kirshenbaum *In* FAA, Proceedings of the First International

Symposium on Explosive Detection Technology May 1992 p 739-740 (For primary document see N93-21856 07-03)
Avail: CASI HC A01/MF A10

N93-21929# Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ.
DETECTION OF TAGGANT IN MODIFIED COMPOSITION C-4 TAGGED WITH A TAGGANT
Tung-Ho Chen, C. Campbell, and R. A. Reed *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 741-751 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.

For biological materials see *55 Space Biology.*

N93-20178*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THE SECOND INTERNATIONAL MICROGRAVITY COMBUSTION WORKSHOP
Feb. 1993 347 p Workshop held in Cleveland, OH, 15-17 Sep. 1992 Original contains color illustrations
(RTOP 674-22-05)
(NASA-CP-10113; E-7309; NAS 1.55:10113) Avail: CASI HC A15/MF A03; 11 functional color pages

This CP contains 40 papers presented at the Second International Microgravity Combustion Workshop held in Cleveland, OH, from September 15 to 17, 1992. The purpose of the workshop was twofold: to exchange information about the progress and promise of combustion science in microgravity and to provide a forum to discuss which areas in microgravity combustion science need to be expanded profitably and which should be included in upcoming NASA Research Announcements (NRA). For individual titles, see N93-20179 through N93-20219.

N93-20179*# National Aeronautics and Space Administration, Washington, DC.
THE WORLD OF NASA MICROGRAVITY SCIENCE
Robert C. Rhome *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 3-8 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

It has been said the decades of the 1990's represents a second golden age of science. We are in the midst of one of the most exciting and interesting periods in the history of exploration -- a period which holds the potential for expanding our understanding of scientific phenomena ranging from intricacies of the universe to the subtleties of our own planet. The opportunities to study the effects of microgravity in space seem limitless during the next decade. Using the European Space Agency (ESA) built Spacelab, we will maximize opportunities for development of new microgravity facilities in order to obtain new information and increase our understanding of the effects of gravitational forces on phenomena in biological, chemical and physical systems. NASA intends to move aggressively, but sensibly, to develop additional space research facilities as we built toward the unique Space Station Freedom resources becoming available towards to end of this decade. Author

N93-20180*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
OVERVIEW OF NASA'S MICROGRAVITY COMBUSTION SCIENCE AND FIRE SAFETY PROGRAM
Howard D. Ross *In its* The Second International Microgravity Combustion Workshop Feb. 1993 p 9-19 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

The study of fundamental combustion processes in a microgravity environment is a relatively new scientific endeavor. A few simple, precursor experiments were conducted in the early 1970's. Today the advent of the U.S. space shuttle and the anticipation of the Space Station Freedom provide for scientists and engineers a special opportunity -- in the form of long duration microgravity laboratories -- and need -- in the form of spacecraft fire safety and a variety of terrestrial applications -- to pursue fresh insight into the basic physics of combustion. Through microgravity, a new range of experiments can be performed since: (1) Buoyancy-induced flows are nearly eliminated; (2) Normally obscured forces and flows may be isolated; (3) Gravitational settling or sedimentation is nearly eliminated; and (4) Larger time or length scales in experiments become permissible.
Derived from text

N93-20181*# Centre National de la Recherche Scientifique, Orleans (France). Lab. de Combustion et Systemes Reactifs.
AN OVERVIEW OF EUROPEAN ACTIVITIES ON MICROGRAVITY COMBUSTION
Iskender Goekalp *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 21-25 (For primary document see N93-20178 07-29)
Avail: CASI HC A01/MF A03; 11 functional color pages

The global objective of the European efforts in microgravity combustion is to combine theoretical and experimental work, both under normal and reduced gravity, to progress in the basic understanding of gravity dependent phenomena in various combustion situations. The first phase of the European activities on microgravity combustion has been summarized in refs. 1, 2, and 3. This overview will summarize the more recent developments. The focus will be on new experimental facilities, new research topics, and new collaborative efforts. Author

N93-20182*# Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan). Research Inst.
JAPAN'S MICROGRAVITY COMBUSTION SCIENCE PROGRAM
Junichi Sato *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 27-32 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

Most of energy used by us is generated by combustion of fuels. On the other hand, combustion is responsible for contamination of our living earth. Combustion, also, gives us damage to our life as fire or explosive accidents. Therefore, clean and safe combustion is now eagerly required. Knowledge of the combustion process in combustors is needed to achieve proper designs that have stable operation, high efficiency, and low emission levels. However, current understanding on combustion is far from complete. Especially, there is few useful information on practical liquid and solid particle cloud combustion. Studies on combustion process under microgravity condition will provide many informations for basic questions related to combustors. Author

N93-20183*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CAPABILITIES AND CONSTRAINTS OF TYPICAL SPACE FLIGHT HARDWARE
John M. Koudelka *In its* The Second International Microgravity Combustion Workshop Feb. 1993 p 35-43 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

The Space Experiments Division is in the business of performing ground based low gravity testing and designing experiment hardware for space flight on the Space Shuttle and in the future, Space Station Freedom. As witnessed in combustion work, the reduction of gravity brings forward previously negligible processes and parameters. In a similar manner, the design of experiments for microgravity operation aboard the Space Shuttle must consider parameters that are often not factors for laboratory hardware. Author

N93-20184*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CAPABILITIES AND CONSTRAINTS OF NASA'S GROUND-BASED REDUCED GRAVITY FACILITIES **c14**
Jack Lekan, Eric S. Neumann, and Raymond G. Sotos *In its* The Second International Microgravity Combustion Workshop Feb. 1993 p 45-60 (For primary document see N93-20178 07-29)
Avail: CASI HC A03/MF A03; 11 functional color pages

The ground-based reduced gravity facilities of NASA have been utilized

to support numerous investigations addressing various processes and phenomina in several disciplines for the past 30 years. These facilities, which include drop towers, drop tubes, aircraft, and sounding rockets are able to provide a low gravity environment (gravitational levels that range from 10(exp -2)g to 10(exp -6)g) by creating a free fall or semi-free fall condition where the force of gravity on an experiment is offset by its linear acceleration during the 'fall' (drop or parabola). The low gravity condition obtained on the ground is the same as that of an orbiting spacecraft which is in a state of perpetual free fall. The gravitational levels and associated duration times associated with the full spectrum of reduced gravity facilities including spaced-based facilities are summarized. Even though ground-based facilities offer a relatively short experiment time, this available test time has been found to be sufficient to advance the scientific understanding of many phenomena and to provide meaningful hardware tests during the flight experiment development process. Also, since experiments can be quickly repeated in these facilities, multistep phenomena that have longer characteristic times associated with them can sometimes be examined in a step-by-step process. There is a large body of literature which has reported the study results achieved through using reduced-gravity data obtained from the facilities. Author

N93-20185*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

CAPABILITIES AND CONSTRAINTS OF COMBUSTION DIAGNOSTICS IN MICROGRAVITY

Paul S. Greenberg *In its* The Second International Microgravity Combustion Workshop Feb. 1993 p 61-66 (For primary document see N93-20178 07-29)

Avail: CASI HC A02/MF A03; 11 functional color pages

A significant scientific return from both existing and proposed microgravity combustion science experiments is substantially dependent on the availability of diagnostic systems for the collection of the required scientific data. To date, the available diagnostic instrumentation has consisted primarily of conventional photographic media and intrusive temperature and velocity probes, such as thermocouples and hot wire anemometers. This situation has arisen primarily due to the unique and severe operational constraints inherent in reduced gravity experimentation. Each of the various reduced gravity facilities is accompanied by its own peculiar envelope of capabilities and constraints. Drop towers, for example, pose strict limitations on available working volume and power, as well as autonomy of operation. In contrast, hardware developed for space flight applications can be somewhat less constrained in regards to the aforementioned quantities, but is additionally concerned with numerous issues involving safety and reliability. Author

N93-20186*# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.

PRIORITIES FOR MICROGRAVITY COMBUSTION RESEARCH AND GOALS FOR WORKSHOP DISCUSSIONS

Gerard M. Faeth *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 67-71 (For primary document see N93-20178 07-29)

Avail: CASI HC A01/MF A03; 11 functional color pages

Several concerns motivate fundamental research: combustion-generated pollutants are re-emerging as a major problem, new combustion technologies are needed for effective energy utilization, municipal and hazardous waste incineration are needed to replace landfills and storage, new combustion technologies are needed for advanced aircraft and spacecraft propulsion systems, and current understanding of fires and explosion hazards is limited - particularly for space-craft environments. Thus, it is of interest to determine how experimentation using microgravity facilities can advance research relevant to these problems. Author (revised)

N93-20187*# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemical Engineering.

FULLERENES FORMATION IN FLAMES **c25**

Jack B. Howard *In* NASA, Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 73-79 (For primary document see N93-20178 07-29)

(Contract DE-FG02-84ER-13282; NIEHS-5-P30-ES02109-10; NIEHS-5-P01-ES01640-11)

Avail: CASI HC A02/MF A03; 11 functional color pages

Fullerenes are composed of carbon atoms arranged in approximately spherical or ellipsoidal cages resembling the geodesic domes designed by Buckminster Fuller, after whom the molecules were named. The approximately spherical fullerene, which resembles a soccer ball and contains sixty atoms (C60), is called buckminsterfullerene. The fullerene containing seventy carbon atoms (C70) is approximately ellipsoidal, similar to a rugby ball. Fullerenes were first detected in 1985, in carbon vapor produced by laser evaporation of graphite. The closed shell structure, which has no edge atoms vulnerable to reaction, was proposed to explain the observed high stability of certain carbon clusters relative to that of others at high temperatures and in the presence of an oxidizing gas. Author

N93-20188*# National Inst. of Standards and Technology, Gaithersburg, MD. Chemical Science and Technology Lab.

PRINCIPLES OF GAS PHASE PROCESSING OF CERAMICS DURING COMBUSTION **c27**

Michael R. Zachariah *In* NASA, Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 81-87 (For primary document see N93-20178 07-29)

Avail: CASI HC A02/MF A03; 11 functional color pages

In recent years, ceramic materials have found applications in an increasingly wider range of industrial processes, where their unique mechanical, electrical and optical properties are exploited. Ceramics are especially useful for applications in high temperature, corrosive environments, which impose particularly stringent requirements on mechanical reliability. One approach to provide such materials is the manufacture of submicron (and more recently nanometer scale) particles, which may subsequently be sintered to produce a material with extremely high mechanical integrity. However, high quality ceramic materials can only be obtained if particles of known size, polydispersity, shape and chemical purity can be produced consistently, under well controlled conditions. These requirements are the fundamental driving force for the renewed interest in studying particle formation and growth of such materials. Author

N93-20189*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

EFFECTS OF BUOYANCY ON LAMINAR, TRANSITIONAL, AND TURBULENT GAS JET DIFFUSION FLAMES **c25**

M. Yousef Bahadori (Science Applications International Corp., Torrance, CA.), Dennis P. Stocker, David F. Vaughan (Baldwin-Wallace Coll., Berea, OH.), Liming Zhou (California Univ., Berkeley.), and Raymond B. Edelman (Rockwell International Corp., Canoga Park, CA.) *In its* The Second International Microgravity Combustion Workshop Feb. 1993 p 91-105 (For primary document see N93-20178 07-29)

(Contracts NAS3-22822; NAS3-25982)

Avail: CASI HC A03/MF A03; 11 functional color pages

Gas jet diffusion flames have been a subject of research for many years. However, a better understanding of the physical and chemical phenomena occurring in these flames is still needed, and, while the effects of gravity on the burning process have been observed, the basic mechanisms responsible for these changes have yet to be determined. The fundamental mechanisms that control the combustion process are in general coupled and quite complicated. These include mixing, radiation, kinetics, soot formation and disposition, inertia, diffusion, and viscous effects. In order to understand the mechanisms controlling a fire, laboratory-scale laminar and turbulent gas-jet diffusion flames have been extensively studied, which have provided important information in relation to the physico-chemical processes occurring in flames. However, turbulent flames are not fully understood and their understanding requires more fundamental studies of laminar diffusion flames in which the interplay of transport phenomena and chemical kinetics is more tractable. But even this basic, relatively simple flame is not completely characterized in relation to soot formation, radiation, diffusion, and kinetics. Therefore, gaining an understanding of laminar flames is essential to the understanding of turbulent flames, and particularly fires, in which the same basic phenomena occur. In order to improve and verify the theoretical models essential to the interpretation of data, the complexity and degree of coupling of the controlling mechanisms must be reduced. If gravity is isolated, the complication of buoyancy-induced convection would be removed from the problem. In addition, buoyant convection in normal gravity masks the effects of other controlling parameters on the flame. Therefore, the combination of normal-gravity and microgravity data would provide the information, both theoretical and experimental, to improve our

understanding of diffusion flames in general, and the effects of gravity on the burning process in particular. Author (revised)

N93-20190*# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.

STRUCTURE AND SOOT PROPERTIES OF NON-BUOYANT LAMINAR ROUND-JET DIFFUSION FLAMES **c25**

Saeed Mortazavi, Peter B. Sunderland, Jongsoo Jurng, and Gerard M. Faeth *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 107-113 (For primary document see N93-20178 07-29)

(Grant NAG3-1245)

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The structure and soot properties of nonbuoyant laminar diffusion flames are being studied experimentally and theoretically in order to better understand the soot and thermal radiation emissions from luminous flames. The measurements involve weakly-buoyant flames at low pressure in normal gravity (ng) and nonbuoyant flames at normal pressures in microgravity (micro g). The objectives of the present investigation are to study the differences of soot properties between nonbuoyant and buoyant diffusion flames, and to evaluate predictions based on the laminar flamelet approach. Derived from text

N93-20191*# Michigan State Univ., East Lansing. Dept. of Mechanical Engineering.

AN EXPERIMENTAL AND THEORETICAL STUDY OF RADIATIVE EXTINCTION OF DIFFUSION FLAMES **c25**

Arvind Atreya, Indrek Wichman, Mark Guenther, Anjan Ray, and Sanjay Agrawal *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 115-120 (For primary document see N93-20178 07-29)

Avail: CASI HC A02/MF A03; 11 functional color pages

In a recent paper on 'Observations of candle flames under various atmospheres in microgravity' by Ross et al., it was found that for the same atmosphere, the burning rate per unit wick surface area and the flame temperature were considerably reduced in microgravity as compared with normal gravity. Also, the flame (spherical in microgravity) was much thicker and further removed from the wick. It thus appears that the flame becomes 'weaker' in microgravity due to the absence of buoyancy generated flow which serves to transport the oxidizer to the combustion zone and remove the hot combustion products from it. The buoyant flow, which may be characterized by the strain rate, assists the diffusion process to execute these essential functions for the survival of the flame. Thus, the diffusion flame is 'weak' at very low strain rates and as the strain rate increases the flame is initially 'strengthened' and eventually it may be 'blown out'. The computed flammability boundaries of T'ien show that such a reversal in material flammability occurs at strain rates around 5 sec. At very low or zero strain rates, flame radiation is expected to considerably affect this 'weak' diffusion flame because: (1) the concentration of combustion products which participate in gas radiation is high in the flame zone; and (2) low strain rates provide sufficient residence time for substantial amounts of soot to form which is usually responsible for a major portion of the radiative heat loss. We anticipate that flame radiation will eventually extinguish this flame. Thus, the objective of this project is to perform an experimental and theoretical investigation of radiation-induced extinction of diffusion flames under microgravity conditions. This is important for spacecraft fire safety. Author

N93-20192*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

SOOT FORMATION AND RADIATION IN TURBULENT JET DIFFUSION FLAMES UNDER NORMAL AND REDUCED GRAVITY CONDITIONS **c25**

Jerry C. Ku (Wayne State Univ., Detroit, MI.), Li Tong (Wayne State Univ., Detroit, MI.), Jun Sun (Wayne State Univ., Detroit, MI.), Paul S. Greenberg, and DeVon W. Griffin (Sverdrup Technology, Inc., Brook Park, OH.) *In its* The Second International Microgravity Combustion Workshop Feb. 1993 p 121-133 (For primary document see N93-20178 07-29)

Avail: CASI HC A03/MF A03; 11 functional color pages

Most practical combustion processes, as well as fires and explosions, exhibit some characteristics of turbulent diffusion flames. For hydrocarbon fuels, the presence of soot particles significantly increases the level of radiative heat transfer from flames. In some cases, flame radiation can reach up to 75 percent of the heat release by combustion. Laminar diffusion flame results show that radiation becomes stronger under reduced gravity conditions. Therefore, detailed soot formation and radiation must be included in the flame structure analysis. A study of sooting turbulent diffusion flames under reduced-gravity conditions will not only provide necessary information for such practical issues as spacecraft fire safety, but also develop better understanding of fundamentals for diffusion combustion. In this paper, a summary of the work to date and of future plans is reported. Author

N93-20193*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

VISUALIZATION AND IMAGING METHODS FOR FLAMES IN MICROGRAVITY **c25**

Karen J. Weiland *In its* The Second International Microgravity Combustion Workshop Feb. 1993 p 135-140 (For primary document see N93-20178 07-29)

Avail: CASI HC A02/MF A03; 11 functional color pages

The visualization and imaging of flames has long been acknowledged as the starting point for learning about and understanding combustion phenomena. It provides an essential overall picture of the time and length scales of processes and guides the application of other diagnostics. It is perhaps even more important in microgravity combustion studies, where it is often the only non-intrusive diagnostic measurement easily implemented. Imaging also aids in the interpretation of single-point measurements, such as temperature, provided by thermocouples, and velocity, by hot-wire anemometers. This paper outlines the efforts of the Microgravity Combustion Diagnostics staff at NASA Lewis Research Center in the area of visualization and imaging of flames, concentrating on methods applicable for reduced-gravity experimentation. Several techniques are under development: intensified array camera imaging, and two-dimensional temperature and species concentrations measurements. A brief summary of results in these areas is presented and future plans mentioned. Author

N93-20194*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

SELECTED MICROGRAVITY COMBUSTION DIAGNOSTIC TECHNIQUES **c25**

DeVon W. Griffin (Sverdrup Technology, Inc., Brook Park, OH.) and Paul S. Greenberg *In its* The Second International Microgravity Combustion Workshop Feb. 1993 p 141-147 (For primary document see N93-20178 07-29)

Avail: CASI HC A02/MF A03; 11 functional color pages

During FY 1989-1992, several diagnostic techniques for studying microgravity combustion have moved from the laboratory to use in reduced-gravity facilities. This paper discusses current instrumentation for rainbow schlieren deflectometry and thermophoretic sampling of soot from gas jet diffusion flames. Author

N93-20195*# United Technologies Research Center, East Hartford, CT.

LASER DIAGNOSTICS FOR MICROGRAVITY DROPLET STUDIES **c25**

Michael Winter *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 149-155 (For primary document see N93-20178 07-29)

Avail: CASI HC A02/MF A03; 11 functional color pages

Rapid advances have recently been made in numerical simulation of droplet combustion under microgravity conditions, while experimental capabilities remain relatively primitive. Calculations can now provide detailed information on mass and energy transport, complex gas-phase chemistry, multi-component molecular diffusion, surface evaporation and heterogeneous reaction, which provides a clearer picture of both quasi-steady as well as dynamic behavior of droplet combustion. Experiments concerning these phenomena typically result in pictures of the burning droplets, and the data therefrom describe droplet surface regression along with flame and soot shell position. With much more precise, detailed, experimental diagnostics, significant gains could be made on the dynamics and flame structural changes which occur during droplet combustion. Since microgravity experiments become increasingly more expensive as they progress from drop towers and flights to spaceborne experiments, there is a great need to maximize the information content from these experiments. Sophisticated measurements using laser diagnostics on individual droplets and combustion phenomena are now possible. These include measuring flow patterns and

temperature fields within droplets, vaporization rates and vaporization enhancement, radical species profiling in flames and gas-phase flow-tagging velocimetry. Although these measurements are sophisticated, they have undergone maturation to the degree where with some development, they are applicable to studies of microgravity droplet combustion. This program beginning in September of 1992, will include a series of measurements in the NASA Learjet, KC-135 and Drop Tower facilities for investigating the range of applicability of these diagnostics while generating and providing fundamental data to ongoing NASA research programs in this area. This program is being conducted in collaboration with other microgravity investigators and is aimed toward supplementing their experimental efforts. Author

N93-20196*# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.

STUDIES OF PREMIXED LAMINAR AND TURBULENT FLAMES AT MICROGRAVITY **c25**

Paul D. Ronney *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 159-164 (For primary document see N93-20178 07-29)

Avail: CASI HC A02/MF A03; 11 functional color pages

The work of the Principal Investigator (PI) has encompassed four topics related to the experimental and theoretical study of combustion limits in premixed flames at microgravity, as discussed in the following sections. These topics include: (1) radiation effects on premixed gas flames; (2) flame structure and stability at low Lewis number; (3) flame propagation and extinction is cylindrical tubes; and (4) experimental simulation of combustion processes using autocatalytic chemical reactions. Author

N93-20197*# Illinois Univ., Urbana. Dept. of Aeronautic and Astronautic Engineering.

MODELING OF MICROGRAVITY COMBUSTION EXPERIMENTS **c25**

John Buckmaster *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 165-170 Sponsored in part by AFOSR (For primary document see N93-20178 07-29)

Avail: CASI HC A02/MF A03; 11 functional color pages

Modeling plays a vital role in providing physical insights into behavior revealed by experiment. The program at the University of Illinois is designed to improve our understanding of basic combustion phenomena through the analytical and numerical modeling of a variety of configurations undergoing experimental study in NASA's microgravity combustion program. Significant progress has been made in two areas: (1) flame-balls, studied experimentally by Ronney and his co-workers; (2) particle-cloud flames studied by Berlad and his collaborators. Additional work is mentioned below. NASA funding for the U. of Illinois program commenced in February 1991 but work was initiated prior to that date and the program can only be understood with this foundation exposed. Accordingly, we start with a brief description of some key results obtained in the pre - 2/91 work. Author

N93-20198*# Naval Research Lab., Washington, DC. Lab. for Computational Physics and Fluid Dynamics.

STRUCTURE AND DYNAMICS OF PREMIXED FLAMES IN MICROGRAVITY **c25**

K. Kailasanath and Gopal Patnaik (Berkeley Research Association, Springfield, VA.) *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 171-176 (For primary document see N93-20178 07-29)

Avail: CASI HC A02/MF A03; 11 functional color pages

In this report we describe the research performed at the Naval Research Laboratory in support of the NASA Microgravity Science and Applications Program over the past three years with emphasis on the work performed since February 1992, the beginning of the current project. The focus of our research has been on investigating fundamental combustion questions concerning the propagation and extinction of gas-phase flames in microgravity and earth-gravity environments. Our approach to resolving these fundamental questions has been to use detailed time-dependent, multidimensional numerical models to perform carefully designed computational experiments. The basic questions we have addressed, a general description of the numerical approach, and a summary of the results are described in this report. More detailed discussions are available in the papers published which are referenced herein. Author (revised)

N93-20199*# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.

ON THE STRUCTURE AND STABILIZATION MECHANISMS OF PLANAR AND CYLINDRICAL PREMIXED FLAMES **c25**

James A. Eng, Delin Zhu, and Chung K. Law *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 177-182 (For primary document see N93-20178 07-29)

Avail: CASI HC A02/MF A03; 11 functional color pages

The configurational simplicity of the stationary one-dimensional flames renders them intrinsically attractive for fundamental flame structure studies. The possibility and fidelity of studies of such flames on earth, however, have been severely restricted by the unidirectional nature of the gravity vector. To demonstrate these complications, let us first consider the premixed flame. Here a stationary, one-dimensional flame can be established by using the flat-flame burner. We next consider nonpremixed flames. First it may be noted that in an unbounded gravity-free environment, the only stationary one-dimensional flame is the spherical flame. Indeed, this is a major motivation for the study of microgravity droplet combustion, in which the gas-phase processes can be approximated to be quasi-steady because of the significant disparity between the gas and liquid densities for subcritical combustion. In view of the above considerations, an experimental and theoretical program on cylindrical and spherical premixed and nonpremixed flames in microgravity has been initiated. For premixed flames, we are interested in: (1) assessing the heat loss versus flow divergence as the dominant stabilization mechanism; (2) determining the laminar flame speed by using this configuration; and (3) understanding the development of flamefront instability and the effects of the flame curvature on the burning intensity. Derived from text

N93-20200*# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.

THE EFFECTS OF GRAVITY ON WRINKLED LAMINAR FLAMES **c25**

Larry W. Kostiuk, Liming Zhou, and Robert K. Cheng *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 183-188 (For primary document see N93-20178 07-29)

(NASA Order C-32000-R)

Avail: CASI HC A02/MF A03; 11 functional color pages

The effects of gravity are significant to the dynamics of idealized unconfined open premixed flames. Moderate to low turbulence Reynolds number flames, i.e., wrinkled laminar flames, of various unconfined geometries have been used extensively for investigating fundamental processes of turbulent flame propagation and to validate theoretical models. Without the wall constraints, the flames are free to expand and interact with surrounding ambient air. The flow field in which the flame exists is determined by a coupling of burner geometry, flame orientation and the gravity field. These complex interactions raise serious questions regarding the validity of comparing the experimental data of open flames with current theoretical and numerical models that do not include the effects of gravity nor effects of the larger aerodynamic flowfield. Therefore, studies of wrinkled laminar flame in microgravity are needed for a better understanding of the role of gravity on flame characteristics such as the orientation, mean aerodynamics stretch, flame wrinkle size and burning rate. Our approach to characterize and quantify turbulent flame structures under microgravity is to exploit qualitative and quantitative flow visualization techniques coupled with video recording and computer controlled image analysis technologies. The experiments will be carried out in the 2.2 second drop tower at the NASA Lewis Research Center. The longest time scales of typical wrinkled laminar flames in the geometries considered here are in the order of 10 msec. Hence, the duration of the drop is sufficient to obtain the amount of statistical data necessary for characterize turbulent flame structures.

Author

N93-20201*# McGill Univ., Montreal (Quebec). Dept. of Mechanical Engineering.

MICROGRAVITY COMBUSTION OF DUST SUSPENSIONS **c25**

John H. S. Lee, Olivier Peraldi, and Rom Knystautas *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 189-195 Sponsored in part by Canadian Space Agency (For primary document see N93-20178 07-29)

Avail: CASI HC A02/MF A03; 11 functional color pages

Unlike the combustion of homogeneous gas mixtures, there are

practically no reliable fundamental data (i.e., laminar burning velocity, flammability limits, quenching distance, minimum ignition energy) for the combustion of heterogeneous dust suspensions. Even the equilibrium thermodynamic data such as the constant pressure volume combustion pressure and the constant pressure adiabatic flame temperature are not accurately known for dust mixtures. This is mainly due to the problem of gravity sedimentation. In normal gravity, turbulence, convective flow, electric and acoustic fields are required to maintain a dust in suspension. These external influences have a dominating effect on the combustion processes. Microgravity offers a unique environment where a quiescent dust cloud can in principle be maintained for a sufficiently long duration for almost all combustion experiments (dust suspensions are inherently unstable due to Brownian motion and particle aggregation). Thus, the microgravity duration provided by drop towers, parabolic flights, and the space shuttle, can all be exploited for different kinds of dust combustion experiments. The present paper describes some recent studies on microgravity combustion of dust suspension carried out on the KC-135 and the Caravelle aircraft. The results reported are obtained from three parabolic flight campaigns.
Author

N93-20202*# California Univ., San Diego, La Jolla. Dept. of Applied Mechanics and Engineering Sciences.
THE STRUCTURE OF PARTICLE CLOUD PREMIXED FLAMES **c25**
K. Seshadri *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 197-202 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

The aim of this study is to provide a numerical and asymptotic description of the structure of planar laminar flames, propagating in a medium containing a uniform cloud of fuel-particles premixed with air. Attention is restricted here to systems where the fuel-particles first vaporize to form a known gaseous fuel, which is then oxidized in the gas-phase. This program is supported for the period September 14, 1991 to September 13, 1992. Some results of the study is shown in Ref. 1. The work summarized in Ref. 1 was initiated prior to September 14, 1991 and was completed on February 1992. Research performed in addition to that described in Ref. 1 in collaboration with Professor A. Linan, is summarized here. Author

N93-20203*# Colorado School of Mines, Golden. Dept. of Metallurgical and Materials Engineering.
COMBUSTION SYNTHESIS OF CERAMIC AND METAL-MATRIX COMPOSITES **c25**
John J. Moore, Heng J. Feng, Kevin J. Hunter, and David G. Wirth (Coors Porcelain Co., Golden, CO.) *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 203-209 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

Combustion synthesis or self-propagating high temperature synthesis (SHS) is effected by heating a reactant mixture, to above the ignition temperature (Tig) whereupon an exothermic reaction is initiated which produces a maximum or combustion temperature, Tc. These SHS reactions are being used to produce ceramics, intermetallics, and composite materials. One of the major limitations of this process is that relatively high levels of porosity, e.g., 50 percent, remain in the product. Conducting these SHS reactions under adiabatic conditions, the maximum temperature is the adiabatic temperature, Tad, and delta H (Tad) = 0, Tad = Tc. If the reactants or products go through a phase change, the latent heat of transformation needs to be taken into account. Author (revised)

N93-20204*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
FIRE SAFETY PRACTICES IN THE SHUTTLE AND THE SPACE STATION FREEDOM **c18**
Robert Friedman *In its* The Second International Microgravity Combustion Workshop Feb. 1993 p 213-225 (For primary document see N93-20178 07-29)
Avail: CASI HC A03/MF A03; 11 functional color pages

The Shuttle reinforces its policy of fire-preventive measures with onboard smoke detectors and Halon 1301 fire extinguishers. The forthcoming Space Station Freedom will have expanded fire protection with photoelectric smoke detectors, radiation flame detectors, and both fixed and portable carbon dioxide fire extinguishers. Many design and operational issues remain to be resolved for Freedom. In particular, the fire-suppression designs must consider the problems of gas leakage in toxic concentrations, alternative systems for single-failure redundancy, and commonality with the corresponding systems of the Freedom international partners. While physical and engineering requirements remain the primary driving forces for spacecraft fire-safety technology, there are, nevertheless, needs and opportunities for the application of microgravity combustion knowledge to improve and optimize the fire-protective systems. Author

N93-20205*# National Inst. of Standards and Technology, Gaithersburg, MD. Building and Fire Research Lab.
IGNITION AND SUBSEQUENT FLAME SPREAD OVER A THIN CELLULOSIC MATERIAL **c25**
Kazuyoshi Nakabe (Osaka Univ., Japan.), Howard R. Baum, and Takashi Kashiwagi *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 229-236 (For primary document see N93-20178 07-29)
Avail: CASI HC A02/MF A03; 11 functional color pages

Both ignition and flame spread on solid fuels are processes that not only are of considerable scientific interest but that also have important fire safety applications. Both types of processes, ignition and flame spread, are complicated by strong coupling between chemical reactions and transport processes, not only in the gas phase but also in the condensed phase. In most previous studies, ignition and flame spread were studied separately with the result that there has been little understanding of the transition from ignition to flame spread. In fire safety applications this transition is crucial to determine whether a fire will be limited to a localized, temporary burn or will transition into a growth mode with a potential to become a large fire. In order to understand this transition, the transient mechanisms of ignition and subsequent flame spread must be studied. However, there have been no definitive experimental or modeling studies, because of the complexity of the flow motion generated by buoyancy near the heated sample surface. One must solve the full Navier-Stokes equations over an extended region to represent accurately the highly unstable buoyant plume and entrainment of surrounding gas from far away. In order to avoid the complicated nature of the starting plume problem under normal gravity, previous detailed radiative ignition models were assumed to be one-dimensional or were applied at a stagnation point. Thus, these models cannot be extended to include the transition to flame spread. The mismatch between experimental and calculated geometries means that theories cannot be compared directly with experimental results in normal gravity. To overcome the above difficulty, theoretical results obtained without buoyancy can be directly compared with experimental data measured in a microgravity environment. Thus, the objective of this study is to develop a theoretical model for ignition and the transition to flame spread and to make predictions using the thermal and chemical characteristics of a cellulosic material which are measured in normal gravity. Author

N93-20206*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
OPPOSED-FLOW FLAME SPREADING IN REDUCED GRAVITY **c25**
Robert A. Altenkirch (Mississippi State Univ., Mississippi State.), Subrata Bhattacharjee (San Diego State Univ., CA.), Sandra L. Olson, and Kurt R. Sacksteder *In its* The Second International Microgravity Combustion Workshop Feb. 1993 p 237-243 (For primary document see N93-20178 07-29)
(Contracts NAS3-23901; NCC3-221)
Avail: CASI HC A02/MF A03; 11 functional color pages

Experimental results obtained in drop towers and in Space Shuttle based experiments coupled with modelling efforts are beginning to provide information that is allowing an understanding to be developed of the physics of opposed-flow flame spread at reduced gravity where the spread rate and flow velocity are comparable and of the role played by radiative and diffusive processes in flame spreading in microgravity. Here we describe one Space Shuttle based experiment on flame spreading in a quiescent environment, the Solid Surface Combustion Experiment, SSCE, one planned microgravity experiment on flame spreading in a radiatively-controlled, forced opposing flow environment, the Diffusive and Radiative Transport in Fires Experiment, DARTFire, modelling efforts to support these experiments, and some results obtained to date. Author

N93-20207*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

COMBUSTION OF SOLID FUEL IN VERY LOW SPEED OXYGEN STREAMS **c25**

James S. Tien (Case Western Reserve Univ., Cleveland, OH.), Kurt R. Sacksteder, Paul V. Ferkul (Case Western Reserve Univ., Cleveland, OH.), and Gary D. Grayson (Case Western Reserve Univ., Cleveland, OH.) *In its* The Second International Microgravity Combustion Workshop Feb. 1993 p 245-250 (For primary document see N93-20178 07-29)

Avail: CASI HC A02/MF A03; 11 functional color pages

In reduced gravity, the combustion of solid fuel in low-speed flow can be studied. The flame behavior in this low-speed regime will fill a void in our understanding of the flow effect on combustion. In addition, it is important for spacecraft fire safety considerations. In this work, modeling and experimental work on low-speed forced-concurrent-flow flame spread are carried out. In addition, experiments on reduced-gravity buoyant-flow flame spread are performed. Author

N93-20208*# California Univ., Berkeley. Dept. of Mechanical Engineering.

A FUNDAMENTAL STUDY OF SMOLDERING COMBUSTION IN MICROGRAVITY **c25**

Carlos Fernandez-Pello and Patrick J. Pagni *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 251-256 (For primary document see N93-20178 07-29)

Avail: CASI HC A02/MF A03; 11 functional color pages

A research program is being conducted to study smoldering combustion in microgravity. The program's final objective is to design and conduct smolder experiments in a space based laboratory, which will complement normal gravity ones, and that will help to: increase the current fundamental understanding of smoldering; predict smolder behavior in a space-based installation; and prevent and control smolder originated, ground or space based, fires. Author

N93-20209*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

FLAME SPREAD ACROSS LIQUID POOLS **c25**

Howard Ross, Fletcher Miller (Case Western Reserve Univ., Cleveland, OH.), David Schiller (California Univ., Irvine.), and William A. Sirignano (California Univ., Irvine.) *In its* The Second International Microgravity Combustion Workshop Feb. 1993 p 257-264 (For primary document see N93-20178 07-29)

Avail: CASI HC A02/MF A03; 11 functional color pages

For flame spread over liquid fuel pools, the existing literature suggests three gravitational influences: (1) liquid phase buoyant convection, delaying ignition and assisting flame spread; (2) hydrostatic pressure variation, due to variation in the liquid pool height caused by thermocapillary-induced convection; and (3) gas-phase buoyant convection in the opposite direction to the liquid phase motion. No current model accounts for all three influences. In fact, prior to this work, there was no ability to determine whether ignition delay times and flame spread rates would be greater or lesser in low gravity. Flame spread over liquid fuel pools is most commonly characterized by the relationship of the initial pool temperature to the fuel's idealized flash point temperature, with four or five separate characteristic regimes having been identified. In the uniform spread regime, control has been attributed to: (1) gas-phase conduction and radiation; (2) gas-phase conduction only; (3) gas-phase convection and liquid conduction, and most recently (4) liquid convection ahead of the flame. Suggestions were made that the liquid convection was owed to both vuoyancy and thermocapillarity. Of special interest to this work is the determination of whether, and under what conditions, pulsating spread can and will occur in microgravity in the absence of buoyant flows in both phases. The approach we have taken to resolving the importance of buoyancy for these flames is: (1) normal gravity experiments and advanced diagnostics; (2) microgravity experiments; and (3) numerical modelling at arbitrary gravitational level. Derived from text

N93-20210*# Colorado Univ., Boulder. Dept. of Mechanical Engineering.

A STUDY OF IGNITION PHENOMENA OF BULK METALS BY RADIANT HEATING **c25**

Melvin C. Branch, A. Abbud-Madrid, T. J. Feiereisen, and J. W. Daily *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 265-271 (For primary document see N93-20178 07-29)

(Grant NAG3-1257)

Avail: CASI HC A02/MF A03; 11 functional color pages

Early research on combustion of metals was motivated by the knowledge of the large heat release and corresponding high temperatures associated with metal-oxygen reactions. The advent of space flight brought about an increased interest in the ignition and combustion of metallic particles as additives in solid rocket propellants. More recently, attention has been given to the flammability properties of bulk, structural metals due to the number of accidental explosions of metal components in high-pressure oxygen systems. The following work represents a preliminary study that is part of a broader research effort aimed at providing further insight into the phenomena of bulk metal combustion by looking at the effects of gravity on the ignition behavior of metals. The scope of this preliminary experimental study includes the use of a non-coherent, continuous radiation ignition source, the measurement of temperature profiles of a variety of metals and a qualitative observation of the ignition phenomena at normal gravity. The specific objectives of the investigation include: (1) a feasibility study of the use of a continuous radiation source for metal ignition; (2) testing and characterization of the ignition behavior of a variety of metals; and (3) building a preliminary experimental database on ignition of metals under normal gravity conditions. Author

N93-20211*# National Aeronautics and Space Administration. White Sands Test Facility, NM.

METALS COMBUSTION IN NORMAL GRAVITY AND MICROGRAVITY **c25**

Theodore A. Steinberg (Lockheed Electronics Co., White Sands Missile Range, NM.), D. Bruce Wilson (Lockheed Electronics Co., White Sands Missile Range, NM.), and Frank J. Benz *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 273-279 (For primary document see N93-20178 07-29)

Avail: CASI HC A02/MF A03; 11 functional color pages

The study of the combustion characteristics of metallic materials has been an ongoing area of research at the NASA White Sands Test Facility (WSTF). This research has been in support of both government and industrial operations and deals not only with the combustion of specific metallic materials but also with the relative flammabilities of these materials under similar conditions. Since many of the metallic materials that are characterized at WSTF for aerospace applications are to be used in microgravity environments, it was apparent that the testing of these materials needed to proceed in a microgravity environment. It was believed that burning metallic materials in a microgravity environment would allow the evaluation of the validity of applying normal gravity combustion tests to characterize metallic materials to be used in microgravity environments. It was also anticipated that microgravity testing would provide insight into the general combustion process of metallic materials. The availability of the NASA Lewis Research Center's (LeRC) 2.2-second drop tower provided the necessary facility to accomplish the microgravity portion of the testing while the normal gravity testing was conducted at NASA WSTF. The tests, both at LeRC and WSTF, were conducted in the same instrumented system and utilized the standard metal flammability test of upward propagation burning of cylindrical rod samples. Author

N93-20212*# California Univ., San Diego, La Jolla. Dept. of Applied Mechanics and Engineering Sciences.

STUDIES OF DROPLET BURNING AND EXTINCTION **c25**

Forman A. Williams *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 283-290 (For primary document see N93-20178 07-29)

Avail: CASI HC A02/MF A03; 11 functional color pages

A project on droplet combustion, pursued jointly with F.L. Dryer of Princeton University, has now been in progress for many years. The project involves experiments on the burning of single droplets in various atmospheres, mainly at normal atmosperic pressure and below, performed in drop towers and designed to be performed aboard space-based platforms such as the Space Shuttle or the Space Station. It also involves numerical computations on droplet burning, performed mainly at Princeton, and asymptotic analyses of droplet burning, performed mainly at UCSD. The focus of the studies rests primarily on time-dependent droplet-burning characteristics and on extinction phenomena. The presentation to be given

here concerns the recent research on application of asymptotic methods to investigation of the flame structure and extinction of hydrocarbon droplets. These theoretical studies are investigating the extent to which combustion of higher hydrocarbons - heptane, in particular - can be described by four-step reduced chemistry of the kind that has achieved a good degree of success for methane flames. The studies have progressed to a point at which a number of definite conclusions can now be stated. These conclusions and the reasoning that led to them are outlined here. Author

N93-20213*# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.

COMPUTATIONAL/EXPERIMENTAL STUDIES OF ISOLATED, SINGLE COMPONENT DROPLET COMBUSTION **c25**

Frederick L. Dryer *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 291-296 (For primary document see N93-20178 07-29)

(Contract NAS3-1231)

Avail: CASI HC A02/MF A03; 11 functional color pages

Isolated droplet combustion processes have been the subject of extensive experimental and theoretical investigations for nearly 40 years. The gross features of droplet burning are qualitatively embodied by simple theories and are relatively well understood. However, there remain significant aspects of droplet burning, particularly its dynamics, for which additional basic knowledge is needed for thorough interpretations and quantitative explanations of transient phenomena. Spherically-symmetric droplet combustion, which can only be approximated under conditions of both low Reynolds and Grashof numbers, represents the simplest geometrical configuration in which to study the coupled chemical/transport processes inherent within non-premixed flames. The research summarized here, concerns recent results on isolated, single component, droplet combustion under microgravity conditions, a program pursued jointly with F.A. Williams of the University of California, San Diego. The overall program involves developing and applying experimental methods to study the burning of isolated, single component droplets, in various atmospheres, primarily at atmospheric pressure and below, in both drop towers and aboard space-based platforms such as the Space Shuttle or Space Station. Both computational methods and asymptotic methods, the latter pursued mainly at UCSD, are used in developing the experimental test matrix, in analyzing results, and for extending theoretical understanding. Methanol, and the normal alkanes, n-heptane, and n-decane, have been selected as test fuels to study time-dependent droplet burning phenomena. The following sections summarizes the Princeton efforts on this program, describe work in progress, and briefly delineate future research directions.

Author (revised)

N93-20214*# California Univ., Davis. Dept. of Mechanical, Aeronautical and Materials Engineering.

COMBUSTION EXPERIMENTS IN REDUCED GRAVITY WITH TWO-COMPONENT MISCIBLE DROPLETS **c25**

Benjamin D. Shaw and Israel Aharon *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 297-302 (For primary document see N93-20178 07-29)

Avail: CASI HC A02/MF A03; 11 functional color pages

The combustion of liquid fuels is a topic worthy of scientific attention on practical and fundamental grounds. Most practical applications of liquid-fuel combustion involve the formation of spray diffusion flames, where droplets frequently burn in groups rather than individually. The combustion is typically complex, with interactions occurring between various physical mechanisms. Many efforts to understand liquid sprays have focused upon studying isolated droplets. Information gained from these studies is often not directly transferable to spray situations. However, isolated-droplet studies are useful in that they allow certain phenomena (e.g., extinction) to be studied under well-controlled and simplified conditions. When theory and experiment agree for simplified situations, predictions for more complex cases (where accurate experimental data may not exist) may be made with more confidence. The simplest droplet combustion scenario is that of an isolated droplet undergoing spherically-symmetric combustion in an environment of infinite extent. The idealization is approached only when forced and buoyant convection are negligible, the droplet is unsupported, and all foreign objects are far-removed from the combustion zone. Appreciable gravity levels compromise spherical symmetry by inducing buoyant convection. Author

N93-20215*# Centre National de la Recherche Scientifique, Orleans (France). Lab. de Combustion et Systemes Reactifs.

STATUS OF THE CNRS-LCSR PROGRAM ON HIGH PRESSURE DROPLET VAPORIZATION AND BURNING **c25**

Christian Chauveau and Iskender Goekalp *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 303-309 Sponsored in part by ESA; CNES; SEP; Commission of the European Communities; European Car Manufacturers; French Army Research Office; and ONERA Original contains color illustrations (For primary document see N93-20178 07-29)

Avail: CASI HC A02/MF A03; 11 functional color pages

Depending on the surrounding flow and thermodynamic conditions, a single droplet may experience several gasification regimes, ranging from the envelope flame regime to pure vaporization. In practical situations, such as rocket propulsion or diesel combustion, the size distribution of droplets is, at best, bimodal, so that the possibility exists for the simultaneous presence of various regimes. For example, very small droplets are transported by the gas phase with zero relative velocity. This picture validates then the spherical symmetry hypothesis applied to the droplet and to the diffusion flame enveloping it. On the other hand, for larger droplets, a relative velocity exists due to drag forces. The most important influence of forced convection on droplet burning is the possibility to extinguish globally the envelope flame, or to establish a flame stabilized in the wake region. The burning rates of these regimes differ strongly. The characteristic time of droplet gasification is also influenced by the surrounding pressure and temperature. A parametric investigation of single droplet burning regimes is then helpful in providing the necessary physical ideas for sub-grid models used in spray combustion numerical prediction codes. The CNRS-LCSR experimental program on droplet vaporization and burning deals with these various regimes: stagnant and convective monocomponent droplet burning convective mono and bicomponent droplet vaporization; high temperature convective mono and biocomponent droplet vaporization; burning regimes of hydrazine and hydroxyl-ammonium-nitrate based monopropellant droplets and the vaporization regimes of liquid oxygen droplets. Studies on interacting droplets and on liquid aluminum droplets will start in the near future. The influence of high pressure is a common feature of all these studies. This paper summarizes the status of the CNRS-LCSR program on the effects of high pressure on monocomponent single droplet burning and vaporization, and some recent results obtained under normal and reduced gravity conditions with suspended droplets are presented. In the work described here, parabolic flights of an aircraft is used to create a reduced gravity environment of the order of 10(exp -2) g. Author

N93-20216*# Tokyo Univ. (Japan). Dept. of Aeronautics.

HIGH-PRESSURE DROPLET COMBUSTION STUDIES **c25**

Masato Mikami, M. Kono, Junichi Sato (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo, Japan.), Daniel L. Dietrich (Sverdrup Technology, Inc., Cleveland, OH.), and Forman A. Williams (California Univ., San Diego, La Jolla.) *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 311-316 (For primary document see N93-20178 07-29)

Avail: CASI HC A02/MF A03; 11 functional color pages

This is a joint research program, pursued by investigators at the University of Tokyo, UCSD, and NASA Lewis Research Center. The focus is on high-pressure combustion of miscible binary fuel droplets. It involves construction of an experimental apparatus in Tokyo, mating of the apparatus to a NASA-Lewis 2.2-second drop-tower frame in San Diego, and performing experiments in the 2.2-second tower in Cleveland, with experimental results analyzed jointly by the Tokyo, UCSD, and NASA investigators. The project was initiated in December, 1990 and has now involved three periods of drop-tower testing by Mikami at Lewis. The research accomplished thus far concerns the combustion of individual fiber-supported droplets of mixtures of n-heptane and n-hexadecane, initially about 1 mm diameter, under free-fall microgravity conditions. Ambient pressures ranged up to 3.0 MPa, extending above the critical pressures of both pure fuels, in room-temperature nitrogen-oxygen atmospheres having oxygen mole fractions X of 0.12 and 0.13. The general objective is to study near-critical and super-critical combustion of these droplets and to see whether three-stage burning, observed at normal gravity, persists at high pressures in microgravity. Results of these investigations will be summarized here; a more complete account soon will be published. Author

N93-20217*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

COMBUSTION OF INTERACTING DROPLET ARRAYS IN A MICROGRAVITY ENVIRONMENT **c25**

Daniel L. Dietrich (Sverdrup Technology, Inc., Cleveland, OH.) and John B. Haggard *In its* The Second International Microgravity Combustion Workshop Feb. 1993 p 317-323 (For primary document see N93-20178 07-29)

Avail: CASI HC A02/MF A03; 11 functional color pages

This research program involves the study of one and two dimensional arrays of droplets in a buoyant-free environment. The purpose of the work is to extend the database and theories that exist for single droplets into the regime where droplet interactions are important. The eventual goal being to use the results of this work as inputs to models on spray combustion where droplets seldom burn individually; instead the combustion history of a droplet is strongly influenced by the presence of the neighboring droplets. The emphasis of the present investigation is experimental, although comparison will be made to existing theoretical and numerical treatments when appropriate. Both normal gravity and low gravity testing will be employed, and the results compared. The work to date will be summarized in the next section, followed by a section detailing the future plans.

Author

N93-20218*# Yale Univ., New Haven, CT. Dept. of Mechanical Engineering.

THE ELECTROSPRAY: FUNDAMENTALS AND COMBUSTION APPLICATIONS **c25**

Alessandro Gomez *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 325-330 (For primary document see N93-20178 07-29)

Avail: CASI HC A02/MF A03; 11 functional color pages

Liquid fuel dispersion in practical systems is typically achieved by spraying the fuel into a polydisperse distribution of droplets evaporating and burning in a turbulent gaseous environment. In view of the nearly unsurmountable difficulties of this two-phase flow, it would be useful to use an experimental arrangement that allow a systematic study of spray evolution and burning in configurations of gradually increasing levels of complexity, starting from laminar sprays to fully turbulent ones. An Electrostatic Spray (ES) of charged droplets lends itself to this type of combustion experiments under well-defined conditions and can be used to synthesize gradually more complex spray environments. In its simplest configuration, a liquid is fed into a small metal tube maintained at several kilovolts relative to a ground electrode few centimeters away. Under the action of the electric field, the liquid meniscus at the outlet of the capillary takes a conical shape, with a thin jet emerging from the cone tip. This jet breaks up farther downstream into a fine spray of charged droplets. Several advantages distinguish the electrospray from alternative atomization techniques: the self-dispersion property of the spray due to coulombic repulsion; the absence of droplet coalescence; the potential control of the trajectories of charged droplets by suitable disposition of electrostatic fields; and the decoupling of atomization, which is strictly electrostatic, from gas flow processes. Furthermore, as recently shown in our laboratory, the electrospray can produce quasi-monodisperse droplets over a very broad size range (1-100 microns). The ultimate objective of this research project is to study the formation and burning of electrosprays of liquid fuels first in laminar regimes and then in turbulent ones. Combustion will eventually be investigated in conditions of three-dimensional droplet-droplet interaction, for which experimental studies have been limited to either qualitative observations in sprays or more quantitative observations on simplified systems consisting of a small number of droplets or droplet arrays. The compactness and potential controllability of this spray generaiton system makes it appealing for studies to be undertaken in the next two years on electrospray combustion in reduced-gravity environments such as those achievable at NASA microgravity test facilities. Author

N93-20219*# Cornell Univ., Ithaca, NY. School of Mechanical and Aerospace Engineering.

CHARACTERIZING DROPLET COMBUSTION OF PURE AND MULTI-COMPONENT LIQUID FUELS IN A MICROGRAVITY ENVIRONMENT **c25**

Gregory S. Jackson and C. Thomas Avedisian *In* NASA. Lewis Research Center, The Second International Microgravity Combustion Workshop Feb. 1993 p 331-337 (For primary document see N93-20178 07-29)

Avail: CASI HC A02/MF A03; 11 functional color pages

The importance of understanding the effects of fuel composition, length scales, and other parameters on the combustion of liquid fuels has motivated the examination of simple flames which have easily characterized flow fields and hence, the potential of being modeled accurately. One such flame for liquid fuel combustion is the spherically symmetric droplet flame which can be achieved in an environment with sufficiently low gravity (i.e., low buoyancy). To examine fundamental characteristics of spherically symmetric droplet combustion, a drop tower facility has been employed to provide a microgravity environment to study droplet combustion. This paper gives a brief review of results obtained over the past three years under NASA sponsorship (grant NAG3-987). Author

N93-21356*# Alabama Univ., Birmingham. Center for Macromolecular Crystallography.

RECENT RESULTS AND NEW HARDWARE DEVELOPMENTS FOR PROTEIN CRYSTAL GROWTH IN MICROACTIVITY

L. J. Delucas, M. M. Long, K. M. Moore, C. Smith, M. Carson, S. V. L. Narayana, D. Carter, A. D. Clark, Jr., R. G. Nanni, and J. Ding [1993] 25 p

(Contract NAS8-36611; NAGw-813)

(NASA-CR-191994; NAS 1.26:191994) Avail: CASI HC A03/MF A01

Protein crystal growth experiments have been performed on 16 space shuttle missions since April, 1985. The initial experiments utilized vapor diffusion crystallization techniques similar to those used in laboratories for earth-based experiments. More recent experiments have utilized temperature induced crystallization as an alternative method for growing high quality protein crystals in microgravity. Results from both vapor diffusion and temperature induced crystallization experiments indicate that proteins grown in microgravity may be larger, display more uniform morphologies, and yield diffraction data to significantly higher resolutions than the best crystals of these proteins grown on earth. Author

N93-21950# National Space Development Agency, Tokyo (Japan).

REPORT ON MICROGRAVITY EXPERIMENT BY TR-1A ROCKET [TR-1A ROKETTO BISHOU JUURYOKU JIKKEN: ICHIGOUKI JIKKEN SEIKA HOUKOKU]

20 May 1992 459 p In JAPANESE Prepared in cooperation with Tohoku Univ., Sendai, Japan; Nissan Motor Co. Ltd., Tokyo, Japan; National Aerospace Lab., Tokyo, Japan; Electrotechnical Lab., Ibarakik, Japan; Mitsubishi Heavy Industries Ltd., Tokyo, Japan; National Research Inst. for Metals, Tokyo, Japan; Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo, Japan; and Nippon Electric Co. Ltd., Tokyo, Japan Original contains color illustrations

(NASDA-EG-920021; JTN-93-80416) Avail: CASI HC A20/MF A04

The details of the five microgravity experiments utilizing six minute microgravity condition available during its flight of Test Rocket-1A (TR-1A) rocket NO. 1 launched on September 16, 1991 and their results are presented. Contents of microgravity experiment conducted are as follows: (1) in-situ observation of crystal growth of cadmium iodide crystals from their solution utilizing the Observation Experiment Equipment System (OBS); (2) in-situ observation of Marangoni convection and capillary wave utilizing the Fluid Dynamic Technology Experiment Equipment (FTX); (3) boiling and bubble generation (pool boiling) experiment utilizing the Bubble Generation, Dynamics and Handling Experiment Equipment (BDH); (4) melting and solidification experiment on particle dispersion strengthened alloy experiment utilizing the Isothermal Furnace (ITF); and (5) melting and solidification experiment of high-temperature oxide superconductor experiment utilizing the High-Temperature Furnace (HTF). The experiment results are presented as follows: (1) precise information was acquired on crystal growth speed, concentration distribution, and temperature distribution; (2) the results of the experiment correlated with those of on-ground simulation; (3) real and interference fringe observation images could be acquired of boiling phenomena; (4) explicit differences were recognized between experiments on the ground and in flight, and more homogeneous dispersion could be attained in the flight experiment; and (5) clear differences in solidified oxide semiconductor textures due to the difference in gravity conditions during their solidification were recognized. Author (NASDA)

N93-21999# Oak Ridge National Lab., TN.
EVALUATION OF HAZ LIQUATION CRACKING SUSCEPTIBILITY AND HAZ SOFTENING BEHAVIOR IN MODIFIED 800H
C. D. Lundin and C. Y. P. Qiao 20 Nov. 1992 115 p Prepared in cooperation with Tennessee Univ., Knoxville, TN
(Contract DE-AC05-84OR-21400)
(DE93-004064; ORNL/SUB-88-07685/03) Avail: CASI HC A06/MF A02

A modified 800H alloy, developed at Oak Ridge National Laboratory (ORNL), is one of the candidate materials designed for high temperature applications. Extensive mechanical and corrosion investigations have been completed and it has been proven that modified 800 has excellent high temperature mechanical and metallurgical behavior. Weldability studies of modified 800H are being carried out at the University of Tennessee, Knoxville. A series of modified 800H alloys and two similar commercial high temperature materials (310Ta and HR3C) were used to conduct this investigation. A preliminary weldability evaluation has been accomplished and the major part of the results (HAZ liquation cracking resistance and HAZ softening behavior in modified 800H) is addressed in this report. The basic conclusion of this investigation is that modified 800H material possesses good resistance to HAZ liquation cracking especially with a grain size control (thermo-mechanical treatment). The information from this study is important to the further modification of the material in order to extend its applications. DOE

N93-20422# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.
RESEARCH ON SPACE COMPONENT AND MATERIAL MANUFACTURING EXPERIMENTS UTILIZING MICROGRAVITY ENVIRONMENT Report No. 1 [BISHOU JUURYOKU KANKYOU RIYOU NI YORU UCHUUYOU BUHIN ZAIRYOU SEIZOU JIKKEN NI KANSURU KENKYUU]
Tadaaki Kurosaki and Tatsurou Ono *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 57-60 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-21075# Canadian Space Agency, Ottawa (Ontario).
MICROGRAVITY SCIENCE ACTIVITIES IN CANADA
M. Z. Saghir *In its* Spacebound 1991 1991 p 18-23 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21076# Canadian Space Agency, Ottawa (Ontario).
UDP SPONSORED OPPORTUNITIES FOR MICROGRAVITY ENVIRONMENT
J. E. Fisher *In its* Spacebound 1991 1991 p 24-28 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21077# Canadian Astronautics Ltd., Ottawa (Ontario).
FLOAT ZONE PROCESSING OF GERMANIUM CRYSTALS ON THE KC-135 MICROGRAVITY AIRCRAFT
C. E. Norman *In* Canadian Space Agency, Spacebound 1991 1991 p 31-35 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21088# Brussels Univ. (Belgium).
PREPARATION RESULTS FOR A MARANGONI-BENARD EXPERIMENT WITH SORET EFFECT UNDER MICROGRAVITY CONDITIONS
S. VanVaerenbergh, P. Colinet, P. Georis, and J. C. Legros *In* Canadian Space Agency, Spacebound 1991 1991 p 85-90 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21090# British Columbia Univ., Vancouver. Dept. of Mechanical Engineering.
GAS BUBBLE GENERATION IN LOW GRAVITY
Z. Abdullah, M. Salcudean, and M. Savage *In* Canadian Space Agency, Spacebound 1991 1991 p 96-10 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21091# University of Western Ontario, London.
DYNAMICS OF SESSILE DROPLETS DISTORTION AND DISRUPTION BY ELECTRIC FIELD IN MICROGRAVITY CONDITIONS
I. I. Inculet, K. Adamiak, H. Rasmussen, K. Abdella, and T. E. Base *In* Canadian Space Agency, Spacebound 1991 1991 p 101-106 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21093# Laval Univ. (Quebec). Dept. of Physics.
AGGLOMERATION OF FRACTALS IN SIMULATED REDUCED GRAVITY
R. J. Slobodrian, M. Cossette, B. Larouche, L. Potvin, and C. Rioux *In* Canadian Space Agency, Spacebound 1991 1991 p 112-117 In FRENCH (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21101# Canadian Space Agency, Ottawa (Ontario).
CANADIAN MICROGRAVITY EXPERIMENTS FLOWN IN 1990-1991
Glen S. Campbell, Lawrence Vezina, and John Aitken (National Research Council of Canada, Ottawa, Ontario.) *In its* Spacebound 1991 1991 p 161-168 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21102# Orbitics, Paris (France).
EXPERIMENTS ABOARD THE CARAVELLE FOR THE 3 ESA CAMPAIGNS IN 1990
Christophe Cornuejols *In* Canadian Space Agency, Spacebound 1991 1991 p 169-173 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21103# Bristol Aerospace Ltd., Winnipeg (Manitoba).
CSAR-1: THE FIRST CANADIAN MICROGRAVITY SOUNDING ROCKET FLIGHT
Kenneth R. Walsh and Corey Mack *In* Canadian Space Agency, Spacebound 1991 1991 p 174-180 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21104# Space Technology Corp., Kearneysville, WV.
INTERNATIONAL AND COMMERCIAL SUB-ORBITAL PROGRAM FOR MICROGRAVITY RESEARCH Abstract Only
J. R. Williams *In* Canadian Space Agency, Spacebound 1991 1991 p 181 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21108# Fiberglas Canada, Inc., Sarnia (Ontario).
POLYMER FOAM CELL GROWTH IN MICROGRAVITY
Margaret M. Curtin, Frank S. Tyler, and David L. Wilkinson *In* Canadian Space Agency, Spacebound 1991 1991 p 200-206 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21109# Saskatchewan Univ., Saskatoon. Dept. of Mechanical Engineering.
AN EXPERIMENT ON PRODUCING FOAM METALS IN A MICROGRAVITY ENVIRONMENT ABOARD NASA KC-135 AIRCRAFT
Kamiel Rezkallah, Scott Huckerby, and Darren Mitchell *In* Canadian Space Agency, Spacebound 1991 1991 p 207-212 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21110# British Columbia Univ., Vancouver. Dept. of Metals and Materials Engineering.
GAS BUBBLES IN LIQUID METALS
F. Weinberg and C. Mui *In* Canadian Space Agency, Spacebound 1991 1991 p 213-218 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21111# Defence and Civil Inst. of Environmental Medicine, Toronto (Ontario).
EYE MOVEMENTS UNDER ALTERED GRAVITOINERTIAL FORCES
Bob S. K. Cheung, Ken E. Money (York Univ., Ontario.), and Ian P. Howard *In* Canadian Space Agency, Spacebound 1991 1991 p 221-223 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21115# Aastra Aerospace, Inc., Downsview (Ontario).
MICROGRAVITY PROCESSING OF CERAMIC COMPOSITES
W. Kung, C. Rucker, and G. Shapiro *In* Canadian Space Agency, Spacebound 1991 1991 p 237-240 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21116# Martec Ltd., Halifax (Nova Scotia).
FINITE ELEMENT ANALYTICAL TECHNIQUES FOR CERAMIC PRODUCTION IN MICROGRAVITY-2
F. Taheri and D. A. Crick (Advanced Materials Engineering Centre, Halifax, Nova Scotia.) *In* Canadian Space Agency, Spacebound 1991 1991 p 241-246 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21117# ORTECH International, Mississauga (Ontario).
THE PRODUCTION OF HIGH IRON GLASSES BY RST IN MICROGRAVITY Abstract Only
B. H. Fox and B. G. Sellars *In* Canadian Space Agency, Spacebound 1991 1991 p 247 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21118# BM Hi-Tech, Inc., Collingwood (Ontario).
EFFECT OF GRAVITY ON PHASE SEPARATION AND CRYSTALLIZATION IN A HEAVY METAL FLUORIDE GLASS
S. Varma, S. E. Prasad, I. Murley, and T. A. Wheat (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario.) *In* Canadian Space Agency, Spacebound 1991 1991 p 248-252 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21119# McMaster Univ., Hamilton (Ontario). Dept. of Materials Science and Engineering.
LIQUID/LIQUID PHASE SEPARATION AND CRYSTALLIZATION OF MATERIALS IN MICROGRAVITY ABOARD NASA KC-135 FLIGHTS Abstract Only
S. Johar and G. P. Johari *In* Canadian Space Agency, Spacebound 1991 1991 p 253 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21120# Manitoba Univ., Winnipeg. Metallurgical Sciences Lab.
GRAIN REFINEMENT OF Al-Cu-Ti ALLOYS IN MICROGRAVITY
J. R. Cahoon, K. N. Tandon, and M. C. Chaturvedi *In* Canadian Space Agency, Spacebound 1991 1991 p 257-260 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21122# Queens Univ., Kingston (Ontario).
RIPENING OF IMMISCIBLE LIQUID DROPLETS IN MICROGRAVITY WITH CONSTRAINED MARANGONI DRIFT
S. Goodman and R. W. Smith *In* Canadian Space Agency, Spacebound 1991 1991 p 265-270 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21125# York Univ. (Ontario).
LASER WELDING OF PLASTICS UNDER LOW AND HIGH GRAVITY CONDITIONS
R. E. Mueller and W. W. Duley (Waterloo Univ., Ontario.) *In* Canadian Space Agency, Spacebound 1991 1991 p 283-288 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N93-20765 Department of the Navy, Washington, DC.
HIGH EFFICIENCY, LOW WEIGHT AND VOLUME ENERGY ABSORBENT SEAM Patent
James A. Buckley, inventor (to Navy) and Elsa J. Hennings, inventor (to Navy) 23 Jun. 1992 7 p Filed 9 Sep. 1991
(AD-D015531; US-Patent-5,123,616; US-Patent-Appl-SN-758919) Avail: US Patent and Trademark Office

A parachute canopy seam joint for fastening a ribbon seam and a radial seam of a parachute canopy together is presented. This parachute canopy seam joint combines a ribbon seam using a zigzag stitch pattern and narrow strips of radial tape sewn together with multiple rows of a straight stitch pattern. The ribbon seam attaches two overlapping ribbons within the parachute. The narrow strips of radial tape shroud the ribbon seam which result in a high strength and low weight and volume radial seam and seam joint. This new configuration of a parachute seam joint has distinct advantages in terms of strength and shock absorbing capacity. Specifically, this new parachute seam joint has a seam strength equal to or greater than the minimum rated strength of the ad-joining materials and employs a smaller weight and volume of material than conventional radial seams and seam joints. GRA

N93-21397# Universiteit Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
ACCURATE TEST LIMITS WITH ESTIMATED PARAMETERS
Willem Albers, Wilbert C. M. Kallenberg, and Gertjan D. Otten Jan. 1992 37 p
(MEMO-1024; ETN-93-92452) Avail: CASI HC A03/MF A01

An approach to setting test limits for production processes, based on a simple approximation to the bivariate normal distribution, is presented. Due to measurement errors, producers are typically forced to set test limits well within specification limits. The methods used in practice are rather informal and usually conservative with respect to consumer loss, thus leading to unnecessary loss of yield. Approximations for test limits which are still relatively easy to evaluate are presented. The analytical tractability of these approximations allows extension to the more realistic case where parameters are estimated. ESA

N93-21463# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).
THE GERMAN NATIONAL INDUSTRY AS A SOURCE OF LOGISTIC SUPPORT FOR ARMED FORCES FACING NEW REQUIREMENTS [DIE NATIONALE INDUSTRIE ALS QUELLE FUER DIE LOGISTISCHE UNTERSTUETZUNG DER STREITKRAEFTE VON NEUEN ANFORDERUNGEN]
Carl Peter Fichtmueller 1991 22 p In GERMAN Presented at DWT Forum: Die Logistik der Bundeswehr von dem Hintergrund der sicherheitspolitischen Veraenderungen - Strukturvorgaben der Streitkraefte und Moeglichkeiten der Industrieunterstuetzung, Aachen, Germany, 14-15 Nov. 1991
(MBB-UL-0002-91-PUB; ETN-93-93441) Avail: CASI HC A03/MF A01

The necessity of an integration of industry in the logistics of the armed forces is emphasized. As far as military equipment is concerned, the armed forces are the customers of industry. Reconstitution capabilities of military equipment planning are outlined. Maintenance, repairing, and spare parts supply are to be rationalized. An increase in efficiency is required in industry's contribution to the armed forces. The emphasis is put on optimization. Examples are given. Transitioning from analog to digital equipment brings a fundamental improvement to the reliability of electronic instruments.
ESA

N93-21465# American Gas Association Labs., Cleveland, OH.
ENGINE DRIVEN CHILLER AND THERMAL STORAGE INTEGRATION (LARGE TONNAGE ENGINE DRIVEN CHILLER DEVELOPMENT) Final Report, Sep. 1988 - Jun. 1991
L. Ericksen Nov. 1991 135 p
(Contract GRI-5088-293-1716)
(PB92-227891; GRI-91/0258) Avail: CASI HC A07/MF A02

The cost of electricity when air conditioning is a prominent demand load for the utility is rapidly increasing. This increased cost has attracted building owners and engineers to demand reduction strategies. Engine chillers and thermal storage are demand reduction products for commercial cooling needs. The combination of these products into one commercially attractive product is the goal of this project. An economic assessment and a lab testing program were completed. These efforts have produced field design equations, performance information, and a generic control scheme. Clear understanding of the competitive advantages of engine chiller/thermal storage over various electric thermal storage options for the customer has been achieved. Cost targets for engine chillers and for thermal storage to match the capital cost of the lowest cost electric thermal storage option have been defined.
GRA

N93-21468# National Inst. of Standards and Technology, Gaithersburg, MD.
METRIC TRANSITION PLANS AND ACTIVITIES OF FEDERAL GOVERNMENT AGENCIES
Gary P. Carver, Raymond A. OBrien, Jr. (Internal Revenue Service, Washington, DC.), and Byron Nupp (Department of Transportation, Washington, DC.) Sep. 1992 113 p
(PB92-222249; NISTIR-4911) Avail: CASI HC A06/MF A02

The report presents an overview of the metric transition planning efforts of federal agencies. It contains summaries of the individual federal agencies' metric transition plans. It includes a set of criteria for evaluating the quality of an agency metric transition plan. Also included is a description of an overall, 'aggregate', appraisal that results when the criteria are applied to the entire federal agency planning effort as though it were a single comprehensive plan. The report is intended for use by federal agencies, as well as by any organizations and individuals whose business-related activities are affected by federal agency programs.
GRA

N93-21650# Worcester Polytechnic Inst., MA. Center for Firesafety Studies.
CHARACTERIZATION OF THE CONFINED CEILING JET IN THE PRESENCE OF AN UPPER LAYER IN TRANSIENT AND STEADY-STATE CONDITIONS Final Report, Aug. 1990 - Jul. 1991
Vahid Motevalli and Christina Ricciuti Aug. 1992 51 p
(Grant NIST-NANBOD-1049)
(PB92-238690; NIST/GCR-92/613) Avail: CASI HC A04/MF A01

The report examines data from a study of small-scale fire induced ceiling jet in a confined situation for a smooth horizontal ceiling. These results were obtained from experiments conducted at the National Institute of Standards and Technology, Center for Fire Research using 2.0 and 0.75 kW fires at r/H locations of 0.26 and 0.75. The data gathered from these experiments represent a collection of transient and steady-state temperature and velocity measurements of a confined ceiling jet and upper layer. The results from this data were compared to similar experimental data collected in a previous study for unconfined ceiling jet using the same apparatus. Comparison of the confined and unconfined ceiling jet data, quantification of the developing upper layer, and analysis of heat transfer to the ceiling are presented. Despite the limited data, it is concluded that the unconfined ceiling jet correlations may only be valid at the very early time, prior to development of the upper layer and that steady-state unconfined correlations are certainly invalid for confined conditions. The velocity of the confined ceiling jet within the upper layer is 20-25 percent less than the unconfined case affecting the heat transfer coefficient.
GRA

N93-21745# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).
MAGNETRON SPUTTERING ON 3D COMPONENTS WITH LESS ACCESSIBLE AREAS
Hannelore Benien, Meinhard Meyer, and W. Psyk (Phototronics Solartechnik G.m.b.H., Putzbrunn, Germany.) 1991 6 p Repr. from Metallwissenschaft und Technik, v. 45, no. 3, Mar. 1991 p 246-249
(MBB-Z-0360-91-B-PUB; ETN-92-92746) Avail: CASI HC A02/MF A01

Magnetron sputtering on less accessible parts (holes, edges, bevels) of three dimensional (3D) components and the possibility of substrate motion during sputter deposition to make the coatings more homogeneous are discussed. The sputter plant is described. The substrated materials used were aluminum and carbon fiber reinforced plastics. The experiment to measure the thickness of the sputter coatings in less accessible parts is outlined, and the results are given. It is concluded that the benefits of the versatile sputter technique as regards the coatings can be enhanced, if such coatings are applied to three dimensional components. This is important specially in the aerospace industry, where specific components have to be coated featuring extremely high quality. Moving and rotating is necessary during sputter deposition in order to coat less accessible areas on three dimensional components entirely and uniformly. The movement of the component depends on its contour. All parts of the contour should be immersed in the plasma in front of the sputter source for the same period of time. Sputter coating onto drill holes is very problematic and is hardly influenced by the process parameters. However, edges and bevels are far more homogeneously coated when the substrate moves (rotates) in the particle and ion flux.
ESA

N93-21748# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
LA RECHERCHE AEROSPATIALE BIMONTHLY BULLETIN, NO. 248, JANUARY - FEBRUARY
Oct. 1989 80 p
(ONERA-1989-1; ESA-TT-1188) Avail: CASI HC A05/MF A01

Topics covered include: (1) methods for computing electromagnetic disturbances inside structures that include composite materials. 1. Basic principles; (2) methods for computing electromagnetic disturbances inside structures that include composite materials. 2. Experimental data; (3) numerical simulation of homogeneous and inhomogeneous gaussian stochastic vector fields; and (4) problems of describing ratchetting effects in cyclic plasticity and viscoplasticity.
CASI

N93-21789# Fiber Dynamics Corp., Murray, UT.
DEVELOPMENT OF AN ALL-COMPOSITE NGV HIGH PRESSURE STORAGE CYLINDER Final Report, Oct. 1989 - Jul. 1991
W. K. Johnson and J. S. Winegar Aug. 1991 34 p Sponsored by Gas Research Inst., Chicago, IL
(Contract GRI-5089-292-1932)
(PB93-114429; GRI-91/0246) Avail: CASI HC A03/MF A01

The development of an all-composite cylinder for high pressure storage of natural gas on a vehicle was aimed at eliminating the major barrier to widespread use of natural gas as a vehicle fuel--the limited capacity, excessive weight, and high cost of presently available cylinders. The research project demonstrated: (1) the feasibility of structurally containing high pressure (3,000 psi) natural gas through the composite overwrap alone without the use of a metallic liner; (2) a potential approach to the pole piece design and pole piece to liner interface; and (3) the unsuitability of a welded plastic laminate for a liner.
GRA

N93-21815*# Arizona Univ., Tucson.
A TWO-STAGE MAGNETIC REFRIGERATOR FOR ASTRONOMICAL APPLICATIONS WITH RESERVOIR TEMPERATURES ABOVE 4 K
C. Hagmann (California Univ., Berkeley.) and P. L. Richards (California Univ., Berkeley.) 9 Feb. 1993 22 p
(Grants NAGw-2864; NAGw-2121)
(NASA-CR-192365; NAS 1.26:192365) Avail: CASI HC A03/MF A01

We propose a novel adiabatic demagnetization refrigerator (ADR) to produce temperatures as low as 100 mK starting from a high temperature reservoir between 4 and 8 K. The high temperature reservoir for the ADR

can be provided by a mechanical cooler or an unpumped liquid helium bath. This refrigerator can be used to cool bolometric infrared detectors for low background astronomy from mountain tops, balloons or satellites as well as to cool cryogenic x-ray detectors. The two-stage ADR consists of a single magnet with a paramagnetic chromic-cesium-alum (CCA) salt pill to produce the low temperature and paramagnetic gadolinium-gallium-garnet (GGG) as the first stage to intercept heat from the high temperature reservoir. Thermal contact between the paramagnets and the reservoir during magnetization is made with a mechanical heat switch. The ADR is suspended with Kevlar chords under tension for high mechanical stiffness and low parasitic heat leak. In a single cycle, the ADR maintains a temperature of 100 mK for 10 to 100 hours. This time depends strongly on the magnetic field and reservoir temperature but not on the volume of the paramagnetic material as long as the heat leak is dominated by the suspension. Author

N93-21971# Los Alamos National Lab., NM.
SUPERFLUID STIRLING REFRIGERATOR WITH A COUNTERFLOW REGENERATOR
J. G. Brisson and G. W. Swift 1992 12 p Presented at the 7th International Cryocooler Conference, Santa Fe, NM, 15-19 Nov. 1992
(Contract W-7405-eng-36)
(DE93-003858; LA-UR-92-3853; CONF-921130-1) Avail: CASI HC A03/MF A01

The superfluid Stirling refrigerator (SSR) uses a He-3-He-4 liquid mixture as a working fluid. It operates at temperatures below 2 K where the He-4 component of the working fluid is superfluid. The He-3 component of the working fluid, to first approximation, behaves thermodynamically like an ideal gas in the inert background of superfluid He-4. Using pistons equipped with a superleak bypass, it is possible to expand and compress the He-3 solute 'gas'. The SSR is a Stirling machine equipped with these 'superleaked' pistons to take advantage of the properties of the He-3 solute to cool below 1 K. The proof of principle was shown by Kotsubo and Swift in 1990. There are three other techniques for cooling below 1 K: (1) the He-3-He-4 dilution refrigerator which utilizes the endothermic heat of mixing of He-3 into He-4 to reach temperatures below 0.010 K; (2) the evaporation of He-3 which can reach temperatures of 0.3 K; and, (3) adiabatic demagnetization of a paramagnetic salt. There are several advantages of the SSR over each of the other techniques. The power consumption of a dilution refrigerator is typically on the order of kilowatts; whereas, the SSR consumes hundreds of watts. The SSR has the potential to cool below 0.3 K and out-perform the evaporative He-3 refrigerator. Adiabatic demagnetization often requires magnetic shielding between the refrigerator and the object to be cooled; obviously, the SSR requires no such shielding. There is an interest in developing subkelvin cryocoolers for satellite-borne X-ray and infrared detectors. In space applications, the power consumption of an SSR can be reduced to tens of watts. This coupled with the SSR's insensitivity to a zero G environment makes it an attractive option to cool detectors in space. DOE

N93-20442# National Space Development Agency, Ibaraki (Japan). Thermal and Structural Engineering Lab.
RESEARCH ON SPACE COOLERS [UCHUUYOU REIKYAKUKI NO KENKYUU]
Haruaki Itagaki, Takanobu Yamamoto, Tooru Iida, Yasuo Ishii, and Keiichi Okuyama *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 149-154 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A02/MF A03

N93-20692# Miami Univ., Coral Gables, FL. Clean Energy Research Inst.
OPTIMIZING LIQUID HYDROGEN STORAGE SYSTEMS
S. Gursu, S. A. Sherif, T. N. Veziroglu, and J. W. Sheffield (Missouri Univ., Rolla.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 540-541 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N93-19962*# Stanford Telecommunications, Inc., Reston, VA.
COMMUNICATIONS SYSTEM EVOLUTIONARY SCENARIOS FOR MARTIAN SEI SUPPORT Final Report
Paulman W. Kwong and Ronald C. Bruno 12 Feb. 1992 71 p
(Contract NAS3-25091)
(NASA-CR-192206; NAS 1.26:192206; TR92-002) Avail: CASI HC A04/MF A01

In the Space Exploration Initiative (SEI) mission scenarios, expanding human presence is the primary driver for high data rate Mars-Earth communications. To support an expanding human presence, the data rate requirement will be gradual, following the phased implementation over time of the evolving SEI mission. Similarly, the growth and evolution of the space communications infrastructure to serve this requirement will also be gradual to efficiently exploit the useful life of the installed communications infrastructure and to ensure backward compatibility with long-term users. In work conducted over the past year, a number of alternatives for supporting high data rate Mars-Earth communications have been analyzed with respect to their compatibility with gradual evolution of the space communications infrastructure. The alternatives include RF, millimeter wave (MMW), and optical implementations, and incorporate both surface and space-based relay terminals in the Mars and Earth regions. Each alternative is evaluated with respect to its ability to efficiently meet a projected growth in data rate over time, its technology readiness, and its capability to satisfy the key conditions and constraints imposed by evolutionary transition. As a result of this analysis, a set of attractive alternative communications architectures have been identified and described, and a road map is developed that illustrates the most rational and beneficial evolutionary paths for the communications infrastructure. Author

N93-19989*# Stanford Telecommunications, Inc., Reston, VA.
MICROWAVE VS OPTICAL CROSSLINK STUDY Final Report
Paulman W. Kwong, Ronald C. Bruno, and Robert G. Marshalek (Ball Aerospace Systems Div., Muncie, IN.) 3 Jan. 1992 127 p
(Contract NAS3-25091)
(NASA-CR-192207; NAS 1.26:192207; TR-91-124) Avail: CASI HC A07/MF A02

The intersatellite links (ISL's) at geostationary orbit is currently a missing link in commercial satellite services. Prior studies have found that potential application of ISL's to domestic, regional, and global satellites will provide more cost-effective services than the non-ISL's systems (i.e., multiple-hop systems). In addition, ISL's can improve and expand the existing satellite services in several aspects. For example, ISL's can conserve the scarce spectrum allocated for fixed satellite services (FSS) by avoiding multiple hopping of the relay stations. ISL's can also conserve prime orbit slot by effectively expanding the geostationary arc. As a result of the coverage extension by using ISL's more users will have direct access to the satellite network, thus providing reduced signal propagation delay and improved signal quality. Given the potential benefits of ISL's system, it is of interest to determine the appropriate implementations for some potential ISL architectures. Summary of the selected ISL network architecture as supplied by NASA are listed. The projected high data rate requirements (greater than 400 Mbps) suggest that high frequency RF or optical implementations are natural approaches. Both RF and optical systems have their own merits and weaknesses which make the choice between them dependent on the specific application. Due to its relatively mature technology base, the implementation risk associated with RF (at least 32 GHz) is lower than that of the optical ISL's. However, the relatively large antenna size required by RF ISL's payload may cause real-estate problems on the host spacecraft. In addition, because of the frequency sharing (for duplex multiple channels communications) within the limited bandwidth allocated, RF ISL's are more susceptible to inter-system and inter-channel interferences. On the other hand, optical ISL's can offer interference-free transmission and compact

sized payload. However, the extremely narrow beam widths (on the order of 10 micro-rad) associated with optical ISL's impose very stringent pointing, acquisition, and tracking requirements on the system. Even if the RF and optical systems are considered separately, questions still remain as to selection of RF frequency, direct versus coherent optical detection, etc. in implementing an ISL for a particular network architecture. These and other issues are studied. Derived from text

N93-19993*# Johns Hopkins Univ., Baltimore, MD. Dept. of Electrical and Computer Engineering.
REDUCED ELECTRICAL BANDWIDTH RECEIVERS FOR DIRECT DETECTION 4-ARY PPM OPTICAL COMMUNICATION INTERSATELLITE LINKS Final Report
Frederic M. Davidson and Xiaoli Sun Feb. 1993 56 p
(Grant NAG5-1510)
(NASA-CR-192310; NAS 1.26:192310) Avail: CASI HC A04/MF A01

One of the major sources of noise in a direct detection optical communication receiver is the shot noise due to the quantum nature of the photodetector. The shot noise is signal dependent and is neither Gaussian nor wide sense stationary. When a photomultiplier tube (PMT) or an avalanche photodiode (APD) is used, there is also a multiplicative excess noise due to the randomness of the internal photodetector gain. Generally speaking, the radio frequency (RF) communication theory cannot be applied to direct detection optical communication systems because noise in RF communication systems is usually additive and Gaussian. A receiver structure which is mathematically optimal for signal dependent shot noise is derived. Several suboptimal receiver structures are discussed and compared with the optimal receiver. The objective is to find a receiver structure which is easy to implement and gives close to optimal performance. Derived from text

N93-20013# Naval Research Lab., Washington, DC.
DUAL DIFFERENCE FILTERING: A REPLACEMENT FOR INTERPOLATION AND SUBTRACTION TO DETECT CHANGES IN MISREGISTERED SIGNALS
Alan P. Schaum 30 Nov. 1992 38 p
(NR Proj. RA1-1-W-53)
(AD-A259440; NRL/FR/5620-92-9522) Avail: CASI HC A03/MF A01

Dual Difference Filtering (DDF), a symmetric signal processor developed as a means of detecting changes in a pair of displaced digital signals, supplants interpolation and subtraction. For oversampled signals, DDF performance can be described by an error spectrum that is the product of the spectrum of the underlying continuous signal and an attenuation factor that depends only on the filters. For undersampled or stochastic signals, performance is similarly describable, but in an average sense. Simple formulas are found for the attenuation factors in terms of the filters' real or frequency space descriptions. A fundamental equation for error minimization is also derived that is useful when the form of the power spectrum is known. Optimal DDF's are computed for a power-law spectrum that is appropriate for imagery. Also, flexible suboptimal design methods are developed that produce superior performance for a wide range of signal spectra. Typical signal to clutter improvements of 30 dB relative to standard interpolation/subtraction methods are demonstrated. GRA

N93-20014 Department of the Navy, Washington, DC.
REMOTELY CONTROLLED C BAND SIGNAL GENERATOR Patent
Gordon K. Wilson, inventor (to Navy), Linda Ortiz-Gonzalez, inventor (to Navy), and Sid G. Knox, inventor (to Navy) 24 Nov. 1992 12 p Filed 25 Feb. 1992
(AD-D015602; US-Patent-5,166,643; US-Patent-Appl-SN-843796) Avail: US Patent and Trademark Office

A highly accurate remotely controlled C band signal generator which provides a microwave signal to a boresight tower for the purpose of calibrating a radar system. The C band signal generator comprises a data receiver circuit for receiving a serial digital data frame having a plurality of eight bit digital data words and for converting the words from serial to parallel. A pulse repetition generator circuit responsive to one of the eight bit digital data words provides a modulating signal having a first or second pulse repetition frequency. The modulating signal when supplied to a pin diode modulator amplitude modulates the microwave signal which is provided by a voltage tunable oscillator. An attenuation driver circuit responsive to a second of the eight bit words provides an analog signal to a first attenuator which attenuates the microwave signal by one decibel steps and also provides a digital signal to a second attenuator which attenuates the microwave signal by ten decibel steps thus providing for attenuation of the microwave signal within a range of zero to eighty-one decibels. In response to three of the eight bit words a pair of phase lock loop circuits provide a stable voltage control signal to the voltage control oscillator thus assuring frequency stability, of the microwave signal provided by the C band signal generator. GRA

N93-20019# Continuous Electron Beam Accelerator Facility, Newport New, VA.
THE N* PROGRAM AT CEBAF
V. D. Burkert 1992 15 p Presented at the International Conference on the Structure of Baryons and Related Mesons, New Haven, CT, 1-4 Jun. 1992
(Contract DE-AC05-84ER-40150)
(DE93-000829; DOE/ER-40150/197; CEBAF-PR-92-021; CONF-920637-7) Avail: CASI HC A03/MF A01

A brief summary of the experimental program at the Continuous Electron Beam Accelerator Facility (CEBAF) to study electro-magnetic transitions of nucleon resonances is given. The need for complete data sets including measurements of polarization observables is stressed. It is emphasized that insight into fundamental properties of hadronic matter can be obtained by studying the Q(sup 2) evolution of resonance transition amplitudes and their comparison with microscopic models of baryons. DOE

N93-20043*# Hawaii Univ., Maui. Dept. of Electrical Engineering.
MULTI-STAGE DECODING FOR MULTI-LEVEL BLOCK MODULATION CODES Technical Report
Shu Lin 27 Aug. 1991 38 p
(Grant NAG5-931)
(NASA-CR-192363; NAS 1.26:192363; Rept-91-002) Avail: CASI HC A03/MF A01

In this paper, we investigate various types of multi-stage decoding for multi-level block modulation codes, in which the decoding of a component code at each stage can be either soft-decision or hard-decision, maximum likelihood or bounded-distance. Error performance of codes is analyzed for a memoryless additive channel based on various types of multi-stage decoding, and upper bounds on the probability of an incorrect decoding are derived. Based on our study and computation results, we find that, if component codes of a multi-level modulation code and types of decoding at various stages are chosen properly, high spectral efficiency and large coding gain can be achieved with reduced decoding complexity. In particular, we find that the difference in performance between the suboptimum multi-stage soft-decision maximum likelihood decoding of a modulation code and the single-stage optimum decoding of the overall code is very small: only a fraction of dB loss in SNR at the probability of an incorrect decoding for a block of 10(exp -6). Multi-stage decoding of multi-level modulation codes really offers a way to achieve the best of three worlds, bandwidth efficiency, coding gain, and decoding complexity. Author

N93-20170*# Nebraska Univ., Lincoln. Dept. of Electrical Engineering and Center for Communication and Information Science.
[STUDY AND SIMULATION OF LOW RATE VIDEO CODING SCHEMES] Semiannual Status Report, 15 Jun. - 15 Dec. 1992
Khalid Sayood, Yun-Chung Chen, and G. Kipp 15 Dec. 1992 112 p
(Grant NAG5-1612)
(NASA-CR-191908; NAS 1.26:191908) Avail: CASI HC A06/MF A02

The semiannual report is included. Topics covered include communication, information science, data compression, remote sensing, color mapped images, robust coding scheme for packet video, recursively indexed differential pulse code modulation, image compression technique for use on token ring networks, and joint source/channel coder design. For individual titles, see N93-20171 through N93-20177.

N93-20171*# Nebraska Univ., Lincoln. Dept. of Electrical Engineering and Center for Communication and Information Science.
[INTRODUCTION TO STUDY AND SIMULATION OF LOW RATE VIDEO CODING SCHEMES]
In its Study and Simulation of Low Rate Video Coding Schemes 15 Dec. 1992 30 p (For primary document see N93-20170 07-32)

(Grant NAG5-1612)
Avail: CASI HC A03/MF A02

During this period, the development of simulators for the various HDTV systems proposed to the FCC were developed. These simulators will be tested using test sequences from the MPEG committee. The results will be extrapolated to HDTV video sequences. Currently, the simulator for the compression aspects of the Advanced Digital Television (ADTV) was completed. Other HDTV proposals are at various stages of development. A brief overview of the ADTV system is given. Some coding results obtained using the simulator are discussed. These results are compared to those obtained using the CCITT H.261 standard. These results in the context of the CCSDS specifications are evaluated and some suggestions as to how the ADTV system could be implemented in the NASA network are made. Derived from text

N93-20172*# Nebraska Univ., Lincoln. Dept. of Electrical Engineering and Center for Communication and Information Science.
DATA COMPRESSION IN REMOTE SENSING APPLICATIONS c43
Khalid Sayood *In its* Study and Simulation of Low Rate Video Coding Schemes 15 Dec. 1992 9 p (For primary document see N93-20170 07-32)
(Grants NAG3-806; NAG5-1612)
Avail: CASI HC A02/MF A02

A survey of current data compression techniques which are being used to reduce the amount of data in remote sensing applications is provided. The survey aspect is far from complete, reflecting the substantial activity in this area. The purpose of the survey is more to exemplify the different approaches being taken rather than to provide an exhaustive list of the various proposed approaches. Derived from text

N93-20173*# Nebraska Univ., Omaha. Medical Center.
COMPRESSION OF COLOR-MAPPED IMAGES c43
A. C. Hadenfeldt and Khalid Sayood (Nebraska Univ., Lincoln.) *In* Nebraska Univ., Study and Simulation of Low Rate Video Coding Schemes 15 Dec. 1992 17 p (For primary document see N93-20170 07-32)
(Grants NAG3-806; NAG5-1612)
Avail: CASI HC A03/MF A02

In a standard image coding scenario, pixel-to-pixel correlation nearly always exists in the data, especially if the image is a natural scene. This correlation is what allows predictive coding schemes (e.g., DPCM) to perform efficient compression. In a color-mapped image, the values stored in the pixel array are no longer directly related to the pixel intensity. Two color indices which are numerically adjacent (close) may point to two very different colors. The correlation still exists, but only via the colormap. This fact can be exploited by sorting the color map to reintroduce the structure. The sorting of colormaps is studied and it is shown how the resulting structure can be used in both lossless and lossy compression of images. Author (revised)

N93-20174*# Nebraska Univ., Lincoln. Dept. of Electrical Engineering and Center for Communication and Information Science.
A ROBUST CODING SCHEME FOR PACKET VIDEO
Yun-Chung Chen, Khalid Sayood, and Don J. Nelson *In its* Study and Simulation of Low Rate Video Coding Schemes 15 Dec. 1992 11 p Revised (For primary document see N93-20170 07-32)
(Grant NAG5-916)
Avail: CASI HC A03/MF A02

A layered packet video coding algorithm based on a progressive transmission scheme is presented. The algorithm provides good compression and can handle significant packet loss with graceful degradation in the reconstruction sequence. Simulation results for various conditions are presented. Author (revised)

N93-20175*# Nebraska Univ., Lincoln. Dept. of Electrical Engineering.
RECURSIVELY INDEXED DIFFERENTIAL PULSE CODE MODULATION
Khalid Sayood and Sangsin Na (Ajou Univ., Suwon, Republic of Korea.) *In its* Study and Simulation of Low Rate Video Coding Schemes 15 Dec. 1992 7 p (For primary document see N93-20170 07-32)
(Grants NAG3-806; NAG5-1615)
Avail: CASI HC A02/MF A02

The performance of a differential pulse code modulation (DPCM) system with a recursively indexed quantizer (RIQ) under various conditions, with first order Gauss-Markov and Laplace-Markov sources as inputs, is studied. When the predictor is matched to the input, the proposed system performs at or close to the optimum entropy constrained DPCM system. If one is willing to accept a 5 percent increase in the rate, the system is very forgiving of predictor mismatch. Author (revised)

N93-20176*# Nebraska Univ., Lincoln. Dept. of Electrical Engineering and Center for Communication and Information Science.
AN IMAGE COMPRESSION TECHNIQUE FOR USE ON TOKEN RING NETWORKS
B. Gorjala, Khalid Sayood, and G. Meempat (Bell Communications Research, Inc., Trenton, NJ.) *In its* Study and Simulation of Low Rate Video Coding Schemes 15 Dec. 1992 20 p (For primary document see N93-20170 07-32)
(Grants NAG5-916; NAG5-1615)
Avail: CASI HC A03/MF A02

A low complexity technique for compression of images for transmission over local area networks is presented. The technique uses the synchronous traffic as a side channel for improving the performance of an adaptive differential pulse code modulation (ADPCM) based coder. Author (revised)

N93-20177*# Nebraska Univ., Lincoln. Dept. of Electrical Engineering and Center for Communication and Information Science.
A JOINT SOURCE/CHANNEL CODER DESIGN
Khalid Sayood, Fuling Liu (Western Atlas Co., Houston, TX.), and Jerry D. Gibson (Texas A&M Univ., College Station.) *In its* Study and Simulation of Low Rate Video Coding Schemes 15 Dec. 1992 16 p (For primary document see N93-20170 07-32)
(Grants NAG3-806; NAG5-916)
Avail: CASI HC A03/MF A02

The situation where there is residual redundancy at the source coder output is examined. This residual redundancy can be used to provide error correction without a channel encoder. This approach is extended to conventional source coder/convolutional coder combinations. A design for nonbinary encoders for this situation is also developed. Through simulation results it is shown that the proposed systems consistently outperform conventional source-channel coder pairs with gains of greater than 10 dB at high probability of error. Author (revised)

N93-20230# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
TOPOLOGICAL APPROACH FOR THE STUDY OF ELECTROMAGNETIC COUPLING Ph.D. Thesis - Univ. des Sciences et Techniques de Lille [APPROCHE TOPOLOGIQUE POUR L'ETUDE DES COUPLAGES ELECTROMAGNETIQUES]
Jean-Philippe Parmantier 1992 350 p In FRENCH
(ONERA-P-1992-2; ETN-93-93044) Avail: CASI HC A15/MF A03

A topological approach used to study electromagnetic coupling on global terms on an aircraft is presented. Descriptive topology concepts are presented. It is shown how this descriptive analysis can be used to structure the quantitative analysis of the coupling. Wiring topology is studied because it lends itself perfectly to the applications in the multiconductor transmission line network formalism. A computer code was developed for these applications. The formalism is generalized to structures other than lines by calculating scattering parameters for several aperture coupling configurations. The results are validated with two experiments in complex structures. The approach is suitable to describe the electromagnetic coupling of aircraft instruments, in order to improve aircraft design and research in the field of electromagnetic compatability. ESA

N93-20233*# Arizona State Univ., Tempe. Telecommunications Research Center.
HIGH-FREQUENCY TECHNIQUES FOR RCS PREDICTION OF PLATE GEOMETRIES AND A PHYSICAL OPTICS/EQUIVALENT CURRENTS MODEL FOR THE RCS OF TRIHEDRAL CORNER REFLECTORS
Semiannual Progress Report, 1 Aug. 1992 - 31 Jan. 1993
Constantine A. Balanis, Lesley A. Polka, and Anastasis C. Polycarpou 31 Jan. 1993 32 p
(Grant NAG1-562)
(NASA-CR-192302; NAS 1.26:192302; TRC-EM-CAB-9301) Avail: CASI HC A03/MF A01

Part 1 of this report continues the investigation, initiated in previous

reports, of scattering from rectangular plates coated with lossy dielectrics. The hard polarization coefficients given in the last report are incorporated into a model, which includes second- and third-order diffractions, for the coated plate. Computed results from this model are examined and compared to measured data. A breakdown of the contribution of each of the higher-order terms to the total radar cross section (RCS) is given. The effectiveness of the uniform theory of diffraction (UTD) model in accounting for the coating effect is investigated by examining a Physical Optics (PO) model which incorporates the equivalent surface impedance approximation used in the UTD model. The PO, UTD, and experimental results are compared. Part 2 of this report presents a RCS model, based on PO and the Method of Equivalent Currents (MEC), for a trihedral corner reflector. PO is used to account for the reflected fields, while MEC is used for the diffracted fields. Single, double, and triple reflections and first-order diffractions are included in the model. A detailed derivation of the E(sub theta)-polarization, monostatic RCS is included. Computed results are compared with finite-difference time-domain (FDTD) results for validation. The PO/MEC model of this report compares very well with the FDTD model, and it is a much faster model in terms of computational speed.
Author (revised)

N93-20257*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COMPRESSING SUBBANDED IMAGE DATA WITH LEMPEL-ZIV-BASED CODERS
Daniel Glover and S. C. Kwatra (Toledo Univ., OH.) Feb. 1993 22 p Proposed for presentation at the Data Compression Conference, Snowbird, UT, 30 Mar. - 1 Apr. 1993; sponsored by the IEEE
(RTOP 144-10-10)
(NASA-TM-105998; E-7600; NAS 1.15:105998) Avail: CASI HC A03/MF A01

A method of improving the compression of image data using Lempel-Ziv-based coding is presented. Image data is first processed with a simple transform, such as the Walsh Hadamard Transform, to produce subbands. The subbanded data can be rounded to eight bits or it can be quantized for higher compression at the cost of some reduction in the quality of the reconstructed image. The data is then run-length coded to take advantage of the large runs of zeros produced by quantization. Compression results are presented and contrasted with a subband compression method using quantization followed by run-length coding and Huffman coding. The Lempel-Ziv-based coding in conjunction with run-length coding produces the best compression results at the same reconstruction quality (compared with the Huffman-based coding) on the image data used.
Author

N93-20260*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MODAL RING METHOD FOR THE SCATTERING OF ELECTROMAGNETIC WAVES
Kenneth J. Baumeister and Kevin L. Kreider (Akron Univ., OH.) Oct. 1993 4 p Proposed for presentation at the 9th Company Conference on the Computation of Electromagnetic Fields, Miami, FL, 31 Oct. - 4 Nov. 1993; sponsored by IEEE
(RTOP 505-62-52)
(NASA-TM-105966; E-7489; NAS 1.15:105966) Avail: CASI HC A01/MF A01

The modal ring method for electromagnetic scattering from perfectly electric conducting (PEC) symmetrical bodies is presented. The scattering body is represented by a line of finite elements (triangular) on its outer surface. The infinite computational region surrounding the body is represented analytically by an eigenfunction expansion. The modal ring method effectively reduces the two dimensional scattering problem to a one-dimensional problem similar to the method of moments. The modal element method is capable of handling very high frequency scattering because it has a highly banded solution matrix.
Author

N93-20273# Surveillance Research Lab., Salisbury (Australia).
REAL TIME DATA REFORMATTING USING THE TMS320C25 DEVELOPMENT SYSTEM
M. Stone Mar. 1992 45 p
(AD-A259187; SRL-0096-TR; DODA-AR-006-969) Avail: CASI HC A03/MF A01

This report assesses the performance of an adaptive sidelobe cancellation system based on the Modified Gram-Schmidt algorithm. A large phased array antenna was modelled utilizing this adaptive sidelobe cancellation technique. The relevant scenarios were simulated. In order to reduce antenna pattern degradation, noise injection was also implemented.
GRA

N93-20277 Department of the Navy, Washington, DC.
IMPROVED VISUAL AID FOR VLF MSK SIGNALS Patent
Lynn K. Thomas, inventor (to Navy) and Paul A. Singer, inventor (to Navy) 1 Sep. 1992 10 p Filed 26 Jun. 1990
(AD-D015576; US-Patent-5,144,643; US-Patent-Appl-SN-543904) Avail: US Patent and Trademark Office

A visual display system provides patterns for visually aiding an operator in determining the nature and noise environment of the incoming signal. A conventional signal receiver and an oscilloscope are coupled to a phase detector, a clock circuit and a frequency synthesizer. The clock circuit synchronizes the operation of the receiver, phase detector and frequency synthesizer. The phase detector includes a digital delay means for imparting a digital time delay between two signals and has two outputs connected to the X and Y deflection terminals of the oscilloscope screen for effecting a display in a lissajous form and another, third output connected to the Z terminal to vary the intensity of a part of the screen such that patterns are generated on the oscilloscope that might represent the inherent nature of the incoming signal which might include, the type of noise, the presence of Doppler shift or CW interference, or drift of a component.
GRA

N93-20306 Department of the Navy, Washington, DC.
METHOD AND APPARATUS FOR PASSIVE DIRECTION FINDING WITH SIDEBAND DETERMINATION Patent
Ralph K. Beyer, inventor (to Navy) and Robert E. Hunt, inventor (to Navy) 15 Sep. 1992 6 p Filed 15 Jul. 1991
(AD-D015546; US-Patent-5,148,180; US-Patent-Appl-SN-729741) Avail: US Patent and Trademark Office

A method and apparatus are provided for passive direction finding that determines the sideband and angle of arrival of an incoming radio signal. A four-channel superheterodyne receiver generates quadrature between the radio signals received by each channel. Four inphase/quadrature phase detectors are connected to the receiver for generating inphase and quadrature components of the electrical phase differences between antenna elements of the receiver. The inphase and quadrature components are used for sideband determination and the electrical phase differences are used to derive the angle of arrival.
GRA

N93-20371# General Electric Co., Moorestown, NJ. Advanced Technology Lab.
RASSP FINAL TECHNICAL REPORT
21 Oct. 1992 143 p
(Contract MDA972-92-R-0017)
(AD-A258562) Avail: CASI HC A07/MF A02

The overall objective of the DARPA/Tri-Service RASSP program is to demonstrate a capability to rapidly specify, produce, and yield domain-specific, affordable signal processors for use in Department of Defense systems such as automatic target acquisition, tracking, and recognition, electronic countermeasures, communications, and SIGINT. The objective of the study phase is to specify a recommended program plan for the government to use as a template for procurement of the RASSP design system and demonstration program. To accomplish that objective, the study phase program tasks are to specify a development methodology for signal processors (adaptable to various organizational design styles, and application areas), analyze the requirements in CAD/CAE tools to support the development methodology, identify the state and development plans of the industry relative to this area, and to recommend the additional developments not currently being addressed by the industry, which are recommended as RASSP developments. In addition, the RASSP study phase will define a linking approach for electronically linking design centers to manufacturing centers so a complete cycle for prototyping can be accomplished with significantly reduced cycle time.
GRA

N93-20392# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
COMPUTER SIMULATION OF A GENERAL PURPOSE SATELLITE

MODEM M.S. Thesis

William L. Montgomery, Jr. Dec. 1992 138 p

(AD-A259083; AFIT/GE/ENG/92D-28) Avail: CASI HC A07/MF A02

The performance of a digital phase shift keyed satellite modem was modeled and simulated. The probability of bit error (P(sub b)) at different levels of energy per bit to noise power ratio (E(sub b)/N(sub o)) was the performance measure. The channel was assumed to contribute only additive white Gaussian noise. A second order Costas loop performs demodulation in the modem and was the key part of the simulation. The Costas loop with second order Butterworth arm filters was tested by finding the response to a phase or frequency step. The Costas loop response was found to be in agreement with theoretical predictions in the absence of noise. Finally, the effect on P(sub b) of a rate 1/2 constraint length 7 convolutional code with eight level soft Viterbi decoding was demonstrated by the simulation. The simulation results were within 0.7 dB of theoretical. All computer simulations were done at baseband to reduce simulation times. The Monte Carlo error counting technique was used to estimate P(sub b). The effect of increasing the samples per bit in the simulation was demonstrated by the 0.4 dB improvement in P(sub b) caused by doubling the number of samples. GRA

N93-20553# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

HIGH RANGE RESOLUTION RADAR TARGET IDENTIFICATION USING THE PRONY MODEL AND HIDDEN MARKOV MODELS M.S. Thesis

Mark R. DeWitt Dec. 1992 130 p

(AD-A259210; AFIT/GE/ENG/92D-15) Avail: CASI HC A07/MF A02

Fully polarized Xpatch signatures are transformed to two left circularly polarized signals. These two signals are then filtered by a linear FM pulse compression ('chirp') transfer function, corrupted by AWGN, and filtered by a filter matched to the 'chirp' transfer function. The bandwidth of the 'chirp' radar is about 750 MHz. Range profile feature extraction is performed using the TLS Prony Model parameter estimation technique developed at Ohio State University. Using the Prony Model, each scattering center is described by a polarization ellipse, relative energy, frequency response, and range. This representation of the target is vector quantized using a K-means clustering algorithm. Sequences of vector quantized scattering centers as well as sequences of vector quantized range profiles are used to synthesize target specific Hidden Markov Models (HMM's). The identification decision is made by determining which HMM has the highest probability of generating the unknown sequence. The data consist of synthesized Xpatch signatures of two targets which have been difficult to separate with other RTI algorithms. The RTI algorithm developed is clearly able to separate these two targets over a 10 by 10 degree (1 degree granularity) aspect angle window off the nose for SNR's as low as 0 dB. The classification rate is 100 percent for SNR's of 5 - 20 dB, 95 percent for a SNR of 0 dB and it drops rapidly for SNR's lower than 0 dB. GRA

N93-20558# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

RECURRENT NEURAL NETWORKS FOR RADAR TARGET IDENTIFICATION M.S. Thesis

Eric T. Kouba Dec. 1992 96 p

(AD-A259127; AFIT/GSO/ENG/92D-02) Avail: CASI HC A05/MF A01

A real-time recurrent learning algorithm was applied to a five class radar target identification problem. The wideband radar was assumed to measure both kinematic (tracking information expressed as estimated aspect angles) and high range resolution data from a single, isolated aircraft. The aspect angles (azimuth and elevation) of the aircraft relative to the radar were assumed to be constantly changing. This created temporal sequences of high range resolution radar signatures that changed as the aspect angles changed. These sequences were used as input features to a recurrent neural network for three radar target identification test cases. The first test case demonstrated the feasibility of using recurrent neural networks for radar target identification. The second test case demonstrated the relationship between sequence length and target recognition accuracy. For the third test case, the recurrent net achieved 96 percent test set accuracy under the following conditions: 5 aircraft classes, azimuth range between 60 deg and 90 deg, elevation range between +5 deg and -5 deg, 1 deg signature granularity, and signatures corrupted by 5 dBsm scintillation noise. GRA

N93-20573 British Broadcasting Corp., Kingswood (England). Engineering Div.

HELITRAK: A HELICOPTER-TRACKING RECEIVER SYSTEM FOR TELEVISION OUTSIDE BROADCAST LINKS

C. Gandy 1992 19 p

(BBC-RD-1992/5) Copyright Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

Helicopters are used by BBC Television for certain live outside broadcasts which require an elevated platform for a camera or for a radio-link mid-point repeater. Video signals are communicated from the helicopter to the ground using microwave radio links, and the signals are received by a narrow-beamwidth dish antenna which must be kept pointing accurately towards the aircraft. In the past, this receiving antenna has always been pointed manually, but in some circumstances the performance of the radio links can be limited by the ability of an operator to keep the antenna on track. Such a limitation can be avoided by using an automatic tracking system; this report describes the approach taken by the Research Department to develop the 'HELITRAK' tracking receiver system. Unlike some of the proprietary counterparts, this is a set of equipment which facilitates automatic tracking when applied to an existing radio-link receiver. It is specially tailored to the requirements of a video transmission system and needs only one conventionally transmitted radio-link signal. It has the potential to increase the reliability and the maximum range of helicopter links, and to improve operational efficiency. The text covers the development of the tracking system, detailing the operational requirements and the design options. The system uses a novel method of tracking by detecting the direction of incoming RF signals, using higher-order mode synthesis in the antenna feed. Operational experience (from use in live outside broadcasts) and system limitations are noted, and areas for further improvements are identified. Author

N93-20578# Naval Research Lab., Washington, DC.

DEMONSTRATION OF A 532 nm DIRECT DETECTION IMAGING LASER RADAR USING A DIGICON RECEIVER Final Report, Sep. 1988 - Nov. 1990

S. C. Hiser, G. L. Blodgett, J. A. Welch, M. G. Roe, and T. H. Cosden 30 Nov. 1992 82 p

(AD-A259226; NRL/FR/5632-92-9518) Avail: CASI HC A05/MF A01

A 532 nm direct-detection imaging laser radar, using a prototype Digicon receiver, was constructed and has demonstrated rapid multiple retargeting over a wide field of regard. The laser radar obtained single-shot images with both intensity data and three-dimensional position data for each target. Such laser radar capability is important for discrimination and targeting. The Digicon receiver system obtains 8 x 8 pixel images of multiple targets at a rate of 15 Hz. Each image provides both intensity and range-to-target at each pixel. Results of experiments involving seven targets located at various distances along a 60 m light tunnel are presented. Future directions discussed include acquisition and hand-off, tracking, long-range experiments (approximately 1 km), and a 16 x 16 array Digicon tube with magnification. GRA

N93-20592# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

AN ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF FM-BY-NOISE JAMMING M.S. Thesis

Charles J. Daly Dec. 1992 126 p

(AD-A259124; AFIT/GE/ENG/92D-14) Avail: CASI HC A07/MF A02

Among the jamming waveforms used in Electronic Warfare, FM-by-noise is the least understood, and no exhaustive analytical and experimental investigation of the subject is known to exist. This investigation presents a thorough review, consolidation, and elucidation of the theory of FM-by-noise. To explain and predict the behavior of FM-by-noise at RF and IF, three useful ratios, namely the deviation-to-victim ratio, the noise-to-victim ratio, and the sweep-to-victim ratio, are developed. To complement the theory, results of FM-by-noise jamming experiments conducted using commercial test and measurement equipment are presented. Specifically, the time- and frequency-domain behavior of FM-by-noise at RF and IF is studied with the baseband noise bandwidth, peak frequency deviation, and victim receiver bandwidth as parameters. An important feature of the experimental portion of this investigation is the inclusion of reproductions of actual oscilloscope and spectrum analyzer displays illustrating the behavior of FM-by-noise. Finally, the concept of noise quality, as a measure of noise

jammer effectiveness, is reexamined. Three noise quality factors are investigated. An existing noise quality measure is verified, and two alternative noise quality factors are proposed. GRA

N93-20597# Colorado Univ., Boulder. Dept. of Electrical and Computer Engineering.
AN INVESTIGATION OF THE CHANNEL CROSSTALK IN OPTICAL HETERODYNE CONTROLLED PHASED ARRAY RADARS Semiannual Progress Report, 1 Jun. - 30 Nov. 1992
Alan R. Mickelson and Lori E. Primas 25 Nov. 1992 7 p
(Contract N00014-92-J-1190)
(AD-A259168) Avail: CASI HC A02/MF A01

The principal objective of this project is to determine the most efficient means of encoding a microwave/millimeter-wave signal from a patch antenna onto an optical carrier in an electro-optic substrate for subsequent optical processing of the microwave/millimeter-wave signal. Our approach during the last period has been to continue the development of design models that would relate the performance of integrated electro-optic devices to the fabrication parameters used in making them. Our emphasis has been on the design and fabrication of coplanar waveguides for electro-optic devices. This includes the design of a coplanar waveguide coupler at 5 GHz. A new technique for analyzing discontinuities in coplanar waveguides was also developed. GRA

N93-20613*# Notre Dame Univ., IN. Dept. of Electrical Engineering.
ERROR CONTROL TECHNIQUES FOR SATELLITE AND SPACE COMMUNICATIONS Semiannual Status Report
Daniel J. Costello, Jr. Mar. 1993 170 p
(Grant NAG5-557)
(NASA-CR-192368; NAS 1.26:192368) Avail: CASI HC A08/MF A02

The results included in the Ph.D. dissertation of Dr. Fu Quan Wang, who was supported by the grant as a Research Assistant from January 1989 through December 1992 are discussed. The sections contain a brief summary of the important aspects of this dissertation, which include: (1) erasurefree sequential decoding of trellis codes; (2) probabilistic construction of trellis codes; (3) construction of robustly good trellis codes; and (4) the separability of shaping and coding. Derived from text

N93-20739# Beleidscommissie Remote Sensing, Delft (Netherlands).
MULTIFREQUENCY BACKSCATTER MODELLING OF BARE SOIL: ATTEMA, KATS, AND KRUL MODEL APPLIED IN AGRISCATT 1987 DATA
H. J. C. vanLeeuwen (Wageningen Agricultural Univ., Netherlands.) Feb. 1992 116 p
(BCRS Proj. AO-2.20)
(BCRS-91-43; ISBN-90-5411-025-2; ETN-92-92845) Avail: CASI HC A06/MF A02

The Agriscatt 1987 campaign was carried out in the Netherlands at the Flevopolder test site with the objective to obtain accurate radar cross sections of selected fields such as vegetation characteristics and soil properties (soil moisture and soil roughness). Together with the ground data, the average sigma(sup 0) values per field were studied in order to test the bare soil model of Attema, Kats and Krul. This was performed for the six frequencies of the Dutscatterometer measurement system. The model was fitted on the data points (55 average sigma(sup 0) values for 5 different angles of incidence) for the different fields using nonlinear least squared fit procedures. This was done for all fields at once by estimating the two model parameters, representing soil moisture and soil roughness. However, during the measurement a compression of the data occurred, which was discovered at the time of writing the report. Still clear trends in soil moisture, soil roughness in relation to the measured backscatter could be found and compared with values known in literature. In general the bare soil model of Attema, Kats and Krul appeared to be useful in relation to all Dutscat frequencies (except for frequencies 5 and 6, where more convergence problems were encountered). The model appeared to be frequency dependent. The method of model fitting and data handling are focused upon. Specific conclusions in the sense of land use applications could not be drawn, because of the data compression. ESA

N93-20750# Technische Univ., Berlin (Germany). Fachbereich Elektrotechnik.
REDUCTION OF BEND LOSSES FOR TITANIUM DIFFUSED WAVEGUIDES IN LITHIUM NIOBATE Ph.D. Thesis [REDUZIERUNG DER KRUEMMUNGSVERLUSTE IN TITANDIFFUNDIERTEN LITHIUMNIOBAT-WELLENLEITERN]
Mohammad Majd 1992 140 p In GERMAN
(ETN-93-92558) Avail: CASI HC A07/MF A02

The properties of the substrate material are described in detail. Analytical relations are derived for radiation and enclosure losses. Field diffusion in waveguide bends is examined by beam propagation method simulations. A series of measurements are presented and discussed. Different measures are described for the reduction of bend losses, such as the diffusion of magnesium oxide in the external area of the bands, or an asymmetrical widening of wave guide bend. A 90 deg double bend was realized on lithium niobate with 3 dB additional losses, which can find wide application field in integrated optics. ESA

N93-20938# Aerospatiale, Paris (France).
ELECTROMAGNETIC CHARACTERIZATION MEASUREMENTS AT 1000 C IN AEROSPATIALE MICROWAVE DEPARTMENT [ESSAIS DE CARACTERISATION ELECTROMAGNETIQUE A 1000 C AU LABORATOIRE HYPERFREQUENCE]
B. Prache (Aerospatiale Aquitaine, Saint-Medard en Jalles, France.) and P. Lahitte (Aerospatiale Aquitaine, Saint-Medard en Jalles, France.) 1992 6 p In FRENCH
(Rept-921-430-114; ETN-93-91942) Avail: CASI HC A02/MF A01

Various techniques for radioelectric characterization exist at room temperature, but they are more critical to carry out at high temperature. A device which performs complex permittivity measurements of materials up to 1000C is presented. The method consists of a guided propagation measurement: the sample is positioned in a waveguide heated at high temperature by a furnace. This device is particularly convenient considering that it ensures the heating homogeneity of the sample, the dealing with the thermal dilatations, and good radioelectric contacts. ESA

N93-21001# European Space Agency, Paris (France). Standards Approval Board for Space Data Communications.
PACKET TELECOMMAND STANDARD
Apr. 1992 169 p
(ESA-PSS-04-107-Issue-2; ETN-93-93512) Copyright Avail: CASI HC A08/MF A02; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The packet telecommand standard belongs to the ESA Procedures, Specifications, and Standards (PSS) series addressing spacelink standards and protocols, subbranch of space data communications. The purpose is to establish uniform requirements for the implementation of spacecraft packet telecommand systems by ESA. To this end, the standard accomplishes the following: establishes a common framework and provides a common basis for the data structures of ESA spacecraft telecommand streams; allows ESA spacecraft projects to proceed coherently with the implementation of spaceborne telecommand systems which are compatible with the ESA ground systems; potentially provides a high level of commonality between both ESA spaceborne and ground based telecommand systems and the ground systems of other CCSDS (Consultative Committee for Space Data Systems) agencies; and provides recommendations for the definition of a minimum acceptable level to end-to-end performance for telecommand systems conforming to this standard. ESA

N93-21036# Centre National d'Etudes Spatiales, Toulouse (France).
STUDY OF THE GAIN FACTOR (G/T) OF AN ACTIVE ANTENNA [ETUDE DU FACTEUR DE MERITE (G/T) D'UNE ANTENNE ACTIVE]
Valerie Foix and Luc Lapierre Apr. 1992 24 p In FRENCH
(CNES-NT-130; ETN-93-93056) Copyright Avail: CASI HC A03/MF A01

The noise of an active antenna is investigated, by means of the antenna gain and noise temperature ratio (G/T). In an active antenna, amplifiers are integrated in the Beam Forming Network (BFN). At the output of the active antenna, the noise is due to the external noise received by the radiating elements and to the internal noise created by the BFN components as a whole. A G/T expression for the overall antenna including the gain of low noise amplifiers is proposed. In this expression, the noise contribution of the BFN itself appears. A test bench for BFN acceptance testing is

presented in order to estimate the G/T of the active antenna. A location criterion for the amplifiers with respect to their noise figures is provided. The validity of the analysis is proven, and some difficulties brought by the large dimensions of the antennas are highlighted. ESA

N93-21061# Grenoble-1 Univ. (France). Lab. de Modelisation et Calcul.
EVALUATION AND DETECTION OF A SIGNAL CONTAINING AN AUTOREGRESSIVE NOISE Ph.D. Thesis [ESTIMATION ET DETECTION D'UN SIGNAL CONTAMINE PAR UN BRUIT AUTOREGRESSIF]
Abdessamad Ezzahar 1991 137 p In FRENCH
(ETN-93-92684) Avail: CASI HC A07/MF A02

The evaluation and detection of a signal from a jammed signal is investigated. Parameter estimation and hypothesis testing are required. A particular 'signal plus noise' model is considered: the signal is a linear combination of deterministic series, which are contaminated by a first order autoregressive additional noise. The method of analyzing either the asymptotic properties of maximal likelihood estimators, when the signal parameters are known, or the least mean square of noise parameters, when the noise parameters are known is presented. The simultaneous evaluation of signal and noise parameters is discussed, and the asymptotic behavior is considered. A technique based on the analysis of the first steps of the easy square method is investigated. Tests to detect signals by using the methods presented and the implied risks are overviewed. The performance of several evaluation methods is summarized. ESA

N93-21201*# National Oceanic and Atmospheric Administration, Boulder, CO. Wave Propagation Lab.
GUIDE TO MICROWAVE WEIGHTING FUNCTION CALCULATIONS
J. A. Schroeder and E. R. Westwater Jul. 1992 24 p Sponsored by NASA, Washington and DOE
(NASA-CR-192719; NAS 1.26:192719; PB92-227198;
NOAA-TM-ERL-WPL-225) Avail: CASI HC A03/MF A01

The document describes the theory and numerical algorithms that we use to compute weighting functions for an upward-looking microwave radiometer at a given channel frequency and antenna orientation. We use these weighting functions to assess the potential response of hypothetical radiometer systems to changes in atmospheric temperature, pressure, water vapor density, dry air density, and cloud liquid density; given an atmosphere defined by input vertical profiles of pressure, temperature, humidity, and cloud density. Calculations for off-zenith antenna orientations assume a spherically stratified atmosphere. The radiative transfer model that we use is valid for channel frequencies below 1 THz in clear conditions and for frequencies below 100 GHz when clouds are present. GRA

N93-21237# National Inst. of Standards and Technology, Boulder, CO. Electromagnetic Fields Div.
SIMULATION OF THE MERGED SPECTRUM TECHNIQUE FOR ALIGNING PLANAR PHASED-ARRAY ANTENNAS, PART 1
Ronald C. Wittmann, Allen C. Newell, Carl F. Stubenrauch, Michael H. Francis, and K. MacReynolds Oct. 1992 51 p
(PB93-113629; NISTIR-3981) Avail: CASI HC A04/MF A01

The report describes the initial phase of a NIST study of the merged-spectrum technique for determining the element excitations from planar scanning near-field measurements of phased-array antennas. Excitation data are used in adjusting phase shifters to meet design specifications. Measurement uncertainties, steering errors, and various analytic approximations will all introduce errors into the alignment. The study is ultimately directed to quantify the effect of these errors, to more fully understand the merged-spectrum technique, and to recommend possible improvements. The present report covers theory developed to support evaluation of the merged-spectrum technique and gives simulation examples illustrating calculation of near fields from array factor and element patterns. GRA

N93-21365 British Broadcasting Corp., Kingswood (England). Engineering Div.
EFFECTS OF WIND TURBINES ON UHF TELEVISION RECEPTION: FIELD TESTS IN DENMARK, NOVEMBER 1991
D. T. Wright Nov. 1991 23 p
(BBC-RD-1992/7) Copyright Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

As a result of a planning application for a wind farm comprising 20 wind turbines at Tynewydd Farm, Filfach Goch in Mid Glamorgan, it became necessary to produce a report discussing any detrimental effects the proposal might have on UHF television reception. In order to make that report as definitive as possible, it was decided to carry out field tests on the exact model of wind turbine to be used at Tynewydd. This required a field trip to Denmark, and the opportunity was taken to make measurements on two other models of turbine at the same time. This report presents the analysis of the results for all three turbines. Author (revised)

N93-21394# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. Communications.
JOINT PARAMETERS ESTIMATION AND SYMBOLS DETECTION FOR DIGITAL COMMUNICATION OVER LINEAR OR NONLINEAR UNKNOWN CHANNELS
Ghassan Kawas Kaleh and Robert Vallet 25 Nov. 1991 25 p
(TELECOM-Paris-91-D-013; ETN-93-92691) Avail: CASI HC A03/MF A01

An iterative method for joint channel parameters estimation and symbols detection via the Baum-Welch algorithm, or equivalently the expectation-maximization algorithm, is presented. Channel parameters, including noise variance, are estimated using maximum likelihood criterion. Estimates are obtained through the iterative maximization of a function related to the Kullback-Leibler information measure. The Markovian properties of the channel state sequence can calculate the required likelihoods using a forward-backward algorithm. The calculated likelihood functions can give optimal decisions on information symbols which minimize the symbol error probability. The proposed receiver can be used for both linear and nonlinear channels. It improves the system throughput by making savings in the transmission of known symbols, usually employed for channel identification. Simulation results which show fast convergence are presented. ESA

N93-21400*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Satellite Communication Group.
[RESEARCH IN LMSS PROPAGATION] Final Report, Jan. - Aug. 1989
R. M. Barts, W. L. Stutzman, and T. Pratt Sep. 1989 10 p
(Contract JPL-956512)
(NASA-CR-191915; JPL-9950-1383; NAS 1.26:191915; SATCOM-89-8)
Avail: CASI HC A02/MF A01

The Virginia Tech Satellite Communications Group has participated in the Land Mobile Satellite System (LMSS) program through JPL sponsorship since 1985. Involvement has mainly been in modeling and simulation of propagation characteristics and effects. Models developed to predict cummulative fade distributions for fading LMSS signals include LMSSMOD and the Simple Models which approximate LMSSMOD. Models to predict the mean and standard deviation of signal attenuation through roadside vegetation, namely the Average Path Model, were developed. In the area of simulation, efforts have centered around the development of a software simulator that uses data bases derived from experimental data to generate simulated data with arbitrary statistical behavior. This work has progressed to the development of an integrated analysis and simulation package, LIPS. The basic theory and results for the models and simulator have been previously documented in reports and papers. All LMSS activities are summarized and details of this year's efforts are given. Author (revised)

N93-21493# National Inst. of Standards and Technology, Boulder, CO. Electromagnetic Fields Div.
CERTIFICATION PLAN FOR A PLANAR NEAR-FIELD RANGE USED FOR HIGH-PERFORMANCE PHASED-ARRAY TESTING
Michael H. Francis, Andrew G. Repjar, and Douglas P. Kremer Jul. 1992 27 p
(PB92-213305; NISTIR-3991) Avail: CASI HC A03/MF A01

The National Institute of Standards and Technology (NIST) has written a certification plan to ensure that a proposed planar near-field range is capable of measuring high-performance phased arrays. Generally, for a complete plan, one must evaluate many aspects including scanner alignment, near-field probe alignment, alignment of the antenna under test, RF crosstalk, probe position errors, RF path variations, the receiver's dynamic range and linearity, leakage, probe-antenna multiple reflections, truncation effects, aliasing, system drift, room multipath, insertion loss measurements, noise, and software verification. The important aspects of a certification plan specifically written for the measurement of high-performance phased-array

antennas are discussed. Further, they show how the requirements of each aspect depend on the measurement accuracies needed to verify the performance of the array under test. GRA

N93-21558 British Broadcasting Corp., Kingswood (England). Research Dept.
REVIEW OF THE YEAR 1991
1991 33 p
Copyright Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

Research Department is responsible for innovating and assessing new broadcasting systems and techniques and for providing the engineering specialist and operational departments with technical advice based on theoretical studies and experiments. Projects undertaken by the Department impinge upon all the technical aspects of broadcasting, including television cameras, recording, video, audio and optical systems, signal processing, acoustics, transmission systems, service planning, antennas, and propagation. A review of projects and work performed during 1991 is included. Derived from text

N93-21664# Westinghouse Savannah River Co., Aiken, SC.
DELINEATE SUBSURFACE STRUCTURES WITH GROUND PENETRATING RADAR
D. E. Wyatt, L. Z. Hu (New Wave Technology, Houston, TX.), M. Ramaswamy (Houston Advanced Research Center, The Woodlands, TX.), and B. G. Sexton (Microseeps, Inc., Pittsburgh, PA.) 1992 14 p Presented at the Eastern Regional Groundwater Issues Conference, Boston, MA, 13 Oct. 1992
(Contract DE-AC09-89SR-18035)
(DE93-000474; WSRC-MS-92-214; CONF-9210171-1) Avail: CASI HC A03/MF A01

High resolution ground penetrating radar (GPR) surveys were conducted at the Savannah River Site in South Carolina in late 1991 to demonstrate the radar techniques in imaging shallow utility and soil structures. Targets of interest at two selected sites, designated as H- and D-areas, were a buried backfilled trench, buried drums, geologic stratas, and water table. Multiple offset 2-D and single offset 3-D survey methods were used to acquire high resolution radar data. This digital data was processed using standard seismic processing software to enhance signal quality and improve resolution. Finally, using a graphics workstation, the 3D data was interpreted. In addition, a small 3D survey was acquired in The Woodlands, Texas, with very dense spatial sampling. This data set adequately demonstrated the potential of this technology in imaging subsurface features. DOE

N93-21669# Dartmouth Coll., Hanover, NH. School of Engineering.
AN AIRBORNE MILLIMETER-WAVE FM-CW RADAR FOR THICKNESS PROFILING OF FRESHWATER ICE
Norbert E. Yankielun Nov. 1992 87 p
(Contract DAAL03-91-G-0192)
(AD-A259368; CRREL-92-20) Avail: CASI HC A05/MF A01

The ability to profile rapidly and accurately the structure of freshwater ice down to a thickness of a few centimeters over large surfaces of frozen ponds, lakes, and rivers has wide military, industrial, commercial, and recreational application, including safety and trafficability surveys. A prototype broadband millimeter wave (26.5 to 40 GHz) Frequency Modulated-Continuous Wave (FM-CW) radar, employing real-time data acquisition and Digital Signal Processing (DSP) techniques, was developed for continuously recording the thickness profile of freshwater ice. Thickness resolution is better than 3 cm plus or minus 10 percent, which improves on short-pulse and FM-CW radars operating at frequencies less than 10 GHz. These other radars have a best reported thickness resolution of approximately 10 cm with a plus or minus 10 percent accuracy; this is insufficient because a freshwater ice sheet as thin as 5 cm, floating on water, can be safely traversed by an individual of average weight. System specifications include a 15-dBm output RF (Radio Frequency) power level, a 0.066-second sweep rate and less than a 50 dB Signal-to-Noise Ratio (SNR). This radar was tested on the ground and from a helicopter at heights of up to 7 m above ice surfaces at speeds up to 40 km/hr. Pond and river ice sheets between 3 and 35 cm thick, with and without fresh snow cover, and with minimal surface roughness were profiled. Results showed direct correlation between radar and borehole thickness measurements. Losses from volume scattering by imbedded air bubbles did not significantly affect the system's capability to discern the air/ice and ice/water scattering boundaries. GRA

N93-21756# XonTech, Inc., Huntington Beach, CA.
TRACKING RADAR ADVANCED SIGNAL PROCESSING AND COMPUTING FOR KWAJALEIN ATOLL (KA) APPLICATION Final Report, 16 Dec. 1991 - 16 Nov. 1992
Stanley D. Cottrill 16 Nov. 1992 49 p
(Contract DASG60-92-C-0022)
(AD-A259066) Avail: CASI HC A03/MF A01

Two means are examined whereby the operations of KMR during mission execution may be improved through the introduction of advanced signal processing techniques. In the first approach, the addition of real time coherent signal processing technology to the FPQ-19 radar is considered. In the second approach, the incorporation of the MMW radar, with its very fine range precision, to the MMS system is considered. The former appears very attractive and a Phase 2 SBIR has been proposed. The latter does not appear promising enough to warrant further development. GRA

N93-21769# Sandia National Labs., Albuquerque, NM.
ONE-CLASS CLASSIFIERS AND THEIR APPLICATION TO SYNTHETIC APERTURE RADAR TARGET RECOGNITION
M. M. Moya, M. W. Koch, R. J. Fogler, and L. D. Hostetler 1992 8 p Presented at the Institute of Electrical and Electronic Engineers (IEEE) International Conference on Neural Networks, San Francisco, CA, 28 Mar. - 1 Apr. 1993
(Contract DE-AC04-76DP-00789)
(DE93-000716; SAND-92-2104C; CONF-930355-1) Avail: CASI HC A02/MF A01

Target recognition requires the ability to distinguish targets from non-targets, a capability called one-class generalization. To function as a one-class classifier, a neural network must have three types of generalization: within-class, between-class, and out-of-class. We discuss these three types of generalization and identify neural network architectures that meet these requirements. We have applied our one-class classifier ideas to the problem of automatic target recognition in synthetic aperture radar. We have compared three neural network algorithms: an algorithmic version of the Adaptive Resonance Theory (ART-2A), Learning Vector Quantization (LVQ), and Restricted Columb Energy network (RCE). The ART 2-A neural network has given the best results, with 100 percent within-class, and out-of-class generalization. Experiments show that the network's performance is sensitive to vigilance and number of training set presentations. DOE

N93-21788# Institute for Telecommunication Sciences, Boulder, CO.
WIDEBAND PROPAGATION MEASUREMENTS AT 30.3 GHz THROUGH A PECAN ORCHARD IN TEXAS
Peter B. Papazian, David L. Jones, and Richard H. Espeland (Espeland, Richard H., Boulder, CO.) Sep. 1992 137 p
(PB93-111466; NTIA-92-287) Avail: CASI HC A07/MF A02

Wideband propagation measurements were made in a pecan orchard in Texas during April and August of 1990 to examine the propagation characteristics of millimeter-wave signals through vegetation. Measurements were made on tree obstructed paths with and without leaves. The study presents narrowband attenuation data at 9.6 and 28.8 GHz as well as wideband impulse response measurements at 30.3 GHz. The wideband probe (Violette et al., 1983), provides amplitude and delay of reflected and scattered signals and bit-error rate. This is accomplished using a 500 MBit/sec pseudo-random code to BPSK modulate a 28.8 GHz carrier. The channel impulse response is then extracted by cross correlating the received pseudo-random sequence with a locally generated replica. GRA

N93-21960# Sandia National Labs., Albuquerque, NM.
AN OVERVIEW OF SANDIA NATIONAL LABORATORIES' PLASMA SWITCHED, GIGAWATT, ULTRA-WIDEBAND IMPULSE TRANSMITTER PROGRAM
R. S. Clark, L. F. Rinehart, M. T. Buttram, and J. F. Aurand 1992 7 p Presented at the 4th International Conference on Ultra-Wideband, Short-Pulse Electromagnetics, Brooklyn, NY, 8-10 Oct. 1992
(Contract DE-AC04-76DP-00789)
(DE93-003249; SAND-92-0765C; CONF-9210166-2) Avail: CASI HC A02/MF A01

Sandia National Laboratories has developed several repetitive,

ultra-wideband (UWB), impulse transmitters to address impulse source technology and to support experimental applications. The sources fall into two different classes, pulse peaking and pulse shorting depending on how the UWB frequency components are generated. The frequency spectrum of the radiated pulse from these sources include the spectrum of 100-MHz to 3-GHz. Depending upon the source, repetitive operation from single shot to 5-kHz (1-kHz nominal) has been obtained with excellent reliability and repeatability. SNIPER (Sub-Nanosecond Impulse Radiator) is a source which uses an oil peaking switch to obtain a fast risetime (250-pS) pulse of 2-nS duration. The output voltage ranges between few tens of kilovolts to 250-kV. EMBL (EnantioMorphic Blumlein) is a similar device (presently under development) which uses a gas switch to sharpen the trailing edge of a 2-nS pulse to approximately 100-pS. To date, an output voltage of approximately 600-kV has been obtained (700-kV is the design goal). Since the frequency spectra are identical between sources with sharpened leading or trailing edges, alternatively, one can use parallel switches to short the pulse at its peak voltage. The pulse is generated externally and then injected into the antenna. Due to the high powers involved and the need to radiate a broad spectrum of frequencies, Sandia has concentrated on TEM horn antennas with special high voltage feed adapters. Several TEM horns have been built and used during this program. In those cases where higher gains are desired for the higher frequencies, TEM horn-fed, dish antennas have been employed. An overview of the UWB transmitters, including design and operation of the modulators, the PFN'S, the pulse sharpening switches and the antennas will be presented. DOE

N93-20418# National Space Development Agency, Ibaraki (Japan). Total System Analysis Lab.
RESEARCH ON DATA RELAY AND TRACKING SATELLITE SYSTEMS [DETA CHUUKEI TSUISEKI EISEI HISUTEMU NO KENKYUU]
Takao Anzai, Toshio Douura, and Satoshi Nagano *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 39-44 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A02/MF A03

N93-20419# National Space Development Agency, Ibaraki (Japan). Common Equipment Lab.
RESEARCH ON INTERSATELLITE LASER COMMUNICATION [EISEIKAN REZA TSUUSHIN NO KENKYUU]
Satoru Yamamoto, Hiroshi Arikawa, Shigeharu Nakamori, and Tomohiro Araki *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 45-48 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20420# National Space Development Agency, Ibaraki (Japan). Common Equipment Lab.
RESEARCH ON SPACE COMMUNICATION EQUIPMENT TECHNOLOGY: STUDY ON RELAY SYSTEM [UCHUUYOU TSUUSHINKIKI GIKUTSU NO KENKYUU: CHUUKEIKI KEI]
In its Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 49-52 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20429# National Space Development Agency, Ibaraki (Japan). Common Equipment Lab.
RESEARCH ON HOPE COMMUNICATION AND DATA PROCESSING EQUIPMENT [HOPE TSUUSHIN DETA SHORI KIKI NO KENKYUU]
Satoru Yamamoto and Toshio Kikuchi *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 89-92 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20434# National Space Development Agency, Ibaraki (Japan). Common Equipment Lab.
RESEARCH AND DEVELOPMENT OF K-BAND INTERSATELLITE COMMUNICATION EXPERIMENT EQUIPMENT ONBOARD ETS-6 [ETS-6 TOUSAI K BANDO EISEIKAN TSUUSHIN JIKKEN KIKI NO KENKYUU KAIHATSU]
Satoru Yamamoto, Noboru Takata, and Ryuuji Temino *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 117-120 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20446# National Space Development Agency, Ibaraki (Japan). Specific Equipment Lab.
RESEARCH ON PHASED ARRAY ANTENNA [FEZUDARE ANTENA NO KENKYUU]
Toneo Kawanishi and Yasuo Tamai *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 165-168 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20447# National Space Development Agency, Ibaraki (Japan). Specific Equipment Lab.
RESEARCH ON BEAM COMPRESSION TECHNOLOGY [BIMU ASSHUKU GIJUTSU NO KENKYUU]
Toshihiro Sezai and Yuuji Oosawa *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 169-172 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20448# National Space Development Agency, Ibaraki (Japan). Common Equipment Lab.
RESEARCH ON DATA HANDLING TECHNOLOGY [DETA HANDORINGU GIJUTSU NO KENKYUU]
Satoru Yamamoto, Hiroshi Anegawa, and Masahiro Kasuya *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 173-176 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-21419*# Motorola, Inc., Chandler, AZ. Strategic Electronics Div.
RENDEZVOUS RADAR FOR THE ORBITAL MANEUVERING VEHICLE Abstract Only
John W. Locke, Keith A. Olds, and Thomas Quaid *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 13 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21421*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
A BINOCULAR STEREO APPROACH TO AR/C AT THE JOHNSON SPACE CENTER Abstract Only
Timothy E. Fisher and Alan T. Smith (Lockheed Engineering and Sciences Co., Houston, TX.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 14-15 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N93-19995# Virginia Univ., Charlottesville. Dept. of Electrical Engineering.
PLANAR MONOLITHIC SCHOTTKY VARACTOR DIODE MILLIMETER-WAVE FREQUENCY MULTIPLIERS Final Report, May 1988 - Dec. 1991
Richard Bradley and Robert J. Mattauch Jun. 1992 442 p
(Contract F19628-88-K-0019)
(AD-A258616; UVA/525694/EE92/113; RL-TR-92-187) Avail: CASI HC A19/MF A04

A critical component of the millimeter-wave superheterodyne receiver is the local oscillator (LO) which is used to pump the low-noise mixer. Frequency multipliers have been used for many years to produce LO

power. Current technology uses the whisker-contacted Schottky varactor diode which is inherently very fragile, expensive to fabricate, difficult to optimize, and requires as many as three mechanical tuners. This report describes the design, fabrication, and evaluation of four planar frequency multipliers. The 'direct-replacement' design demonstrates how a discrete planar varactor can replace a whisker-contacted varactor in a waveguide-type 75/225 GHz tripler and yield comparable performance. The fully monolithic (MMIC) balanced-varactor 80/160 GHz doubler and balanced-varactor 80/240 GHz tripler designs illustrate that MMIC technology is practical throughout the millimeter-wave band. Finally, a high-power 31/94 GHz tripler design is presented. These MMIC multipliers are the first to operate over 100 GHz, use coplanar waveguide extensively, and use inductance cancellation to permit simultaneous tuning of the varactor at the pump, idler, and output frequencies. GRA

N93-20028# Department of the Navy, Washington, DC.
VARIABLE PHASE SINE WAVE GENERATOR FOR ACTIVE PHASED ARRAYS Patent Application
W. M. Waters, inventor (to Navy) 30 Sep. 1992 16 p
(AD-D015558; US-Patent-Appl-SN-953380; Navy-Case-72951) Avail: CASI HC A03/MF A01

A waveform generator is provided for generating a high frequency waveform. A pulse generator provides a pulse train at a low frequency. A pulse converter converts the pulse train into an alternatingly positive and negative groups of pulses. A bandpass filter passes the alternatingly positive and negative groups of pulses in a frequency band centered at the high frequency to output the generated waveform at the high frequency. When the groups of pulses are a pair of pulses, a sine wave is output from the bandpass filter. A pulse delay circuit can be used to variably delay the pulse train and thereby cause a phase change in the generated waveform. GRA

N93-20029# Sandia National Labs., Albuquerque, NM.
ANALYSIS AND MEASUREMENT OF THERMAL RESISTANCE IN A 3-DIMENSIONAL SILICON MULTICHIP MODULE POPULATED WITH ASSEMBLY TEST CHIPS
J. N. Sweet, D. W. Peterson, D. Chu, B. L. Bainbridge, R. A. Gassman, and C. A. Reber 2 Sep. 1992 5 p Presented at the 9th Annual Institute of Electrical and Electronic Engineers (IEEE) Semiconductor Thermal Measurement Symposium, Austin, TX, 2-4 Feb. 1993
(Contract DE-AC04-76DP-00789)
(DE93-000743; SAND-92-1906C; CONF-930233-1) Avail: CASI HC A01/MF A01

Three dimensional multichip modules (MCM's) present an unusual challenge to the thermal designer. For example, high thermal resistance between upper planes of the MCM and the thermally anchored bottom plane can lead to the development of excessive temperatures. As new designs emerge, it becomes desirable to have methods of experimentally determining interior temperatures in the module in order to validate complex finite element calculations. In order to develop methods for assessing the thermal performance of a 3D MCM, a test module with three planes or slices is developed. Some initial calculations and measurements for the 3D MCM are reported. In addition, the improvement in thermal performance obtained by replacing the top slice with a diamond substrate is discussed. Finite element method (FEM) thermal calculations were done with both the workstation based analyzer P/Thermal from PDA Engineering and the PC program, Inertia from Modern Computer Aided Engineering. These analyses have assumed no heat losses by radiation or convection. DOE

N93-20119* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A METHOD OF MAKING A SINGLE LAYER MULTI-COLOR LUMINESCENT DISPLAY Patent
James B. Robertson, inventor (to NASA) 16 Mar. 1993 8 p Filed 24 Mar. 1992 Supersedes N92-30389 (30 - 21, p 3622) Continuation-in-part of US-Patent-Appl-SN-693049, filed 30 Apr. 1991 which is a continuation-in-part of US-Patent-Appl-SN-337768, filed 13 Apr. 1989 which is a division of abandoned US-Patent-Appl-SN-140185, filed 31 Dec. 1987
(NASA-Case-LAR-14811-1; US-Patent-5,194,290;
US-Patent-Appl-SN-858176; US-Patent-Appl-SN-693049;
US-Patent-Appl-SN-337768; US-Patent-Appl-SN-140185;
US-Patent-Class-427-526; US-Patent-Class-427-66; US-Patent-Class-427-68; US-Patent-Class-427-108) Avail: US Patent and Trademark Office

The invention is a method of forming a multi-color luminescent display including the steps of depositing on an insulator substrate a smooth single layer of host material which itself may be a phosphor with the properties to host varying quantities of different impurities and introducing one or more of said different impurities into selected areas of the single layer of host material via an appropriately positioned mask as by thermal diffusion or ion-implantation to form a pattern of phosphors of different colors in the single layer of host material such that the top surface of the host layer remains smooth. Red phosphors are formed by adding impurities selected from the group consisting of Sm, SmF3, Eu, EuF3, and ZnS:MnTbF3 to a ZnS host; green phosphors by adding impurities selected from the group consisting of Tb and TbF3 to a ZnS host; and blue phosphors by adding impurities selected from the group consisting of Tm, Al, Ag, and Mg to a ZnS host.
Official Gazette of the U.S. Patent and Trademark Office

N93-20125# Westinghouse Science and Technology Center, Pittsburgh, PA.
PROCESSING, FABRICATION, AND DEMONSTRATION OF HTS INTEGRATED MICROWAVE CIRCUITS Research and Development Status Report No. 5, 27 Jul. - 25 Oct. 1992
G. R. Wagner 25 Oct. 1992 35 p
(Contract N00014-91-C-0112; ARPA Order 7932)
(AD-A259441) Avail: CASI HC A03/MF A01

These tasks are essentially complete as reported last time, but we are continuing to monitor the progress in other technologies and the evolving subsystems requirements as they relate to the HTS components development. The packaging and characterization work reported here is related to progress made in the parallel High-Temperature Superconducting Space Environment-2 (HTSSE-2) program. We have used the filters and delay line to be delivered to HTSSE-2 as test vehicles for the fabrication and packaging developments achieved in this ONR/DARPA program. Although in this program this approach is appropriate since all the packaging and characterization required for repeatable results are common to all devices made in both programs. GRA

N93-20130# General Electric Co., Schenectady, NY. Research and Development.
DEVELOPMENT OF ELEMENTS OF A HIGH T(SUB c) SUPERCONDUCTING CABLE Annual Report, 1 Jul. 1991 - 30 Jun. 1992
Kenneth W. Lay 1992 13 p
(Contract N00014-88-C-0681)
(AD-A259415) Avail: CASI HC A03/MF A01

The program is aimed at the development of long lengths of silver-clad BSCCO. The material of choice is BSCCO-2223 with 20 K the operating temperature goal. Such a tape conductor ultimately could be used in a coil for a magnet, motor, or generator. The program is designed to tackle several key problems with parallel tasks. A large variety of BSCCO powders are under investigation. Silver tubes are packed with superconductor powder and deformed to form tape conductors. An alternate method of making silver-encapsulated superconducting tape was also pursued. Variations in the powders and processing parameters are used to optimize the tape Jc. GRA

N93-20162*# Aerospace Corp., El Segundo, CA. Engineering and Technology Group.
SPECIAL TESTS AND DESTRUCTIVE PHYSICAL ANALYSES AS USED BY THE AEROSPACE CORPORATION WITH NICKEL-HYDROGEN CELLS
A. H. Zimmerman, M. V. Quinzio, and L. H. Thaller 30 Nov. 1992 32 p
(Contract F04701-88-C-0089)
(NASA-CR-192318; NAS 1.26:192318; ATR-93(3821)-1) Avail: CASI HC A03/MF A01

The destructive physical analysis (DPA) of electrochemical devices is an important part of the overall test. Specific tests were developed to investigate the degradation mode or the failure mechanism that surfaces during the course of a cell being assembled, acceptance tested, and life-cycle tested. The tests that have been developed are peculiar to the cell chemistry under investigation. Tests are often developed by an individual

or group of researchers as a result of their particular interest in an unresolved failure mechanism or degradation mode. A series of production, operational, and storage issues that were addressed by the Electrochemistry Group at The Aerospace Corporation are addressed. As a result of these investigations, as well as associated research studies carried out to develop a clearer understanding of the nickel oxyhydroxide electrode, a series of unique and useful specialized tests were developed. Some of these special tests were assembled to describe the methods that were found to be particularly useful in resolving a wide spectrum of manufacturing, operational, and storage issues related to nickel-hydrogen cells. The general methodology of these tests is given here with references listed to provide the reader with a more detailed understanding of the tests. The tests are classified according to the sequencing, starting with the impregnation of the nickel plaque material and culminating with the storage of completed cells. The details of the wet chemical procedures that were found to be useful because of their accuracy and reproducibility are given. The equations used to make the appropriate calculations are listed. Author

N93-20258*# Akron Univ., OH. Dept. of Electrical Engineering.
CHARACTERIZATION AND SNUBBING OF A BIDIRECTIONAL MCT IN A RESONANT AC LINK CONVERTER
Tony Lee, Malik E. Elbuluk, and Donald S. Zinger [1993] 9 p
(Grant NAG3-1236)
(NASA-CR-192230; NAS 1.26:192230) Avail: CASI HC A02/MF A01

The MOS-Controlled Thyristor (MCT) is emerging as a powerful switch that combines the better characteristics of existing power devices. A study of switching stresses on an MCT switch under zero voltage resonant switching is presented. The MCT is used as a bidirectional switch in an ac/ac pulse density modulated inverter for induction motor drive. Current and voltage spikes are observed and analyzed with variations in the timing of the switching. Different snubber circuit configurations are under investigation to minimize the effect of these transients. The results will be extended to study and test the MCT switching in a medium power (5 hp) induction motor drive. Author

N93-20259*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
FULL WAVE CHARACTERIZATION OF MICROSTRIP OPEN END DISCONTINUITIES PATTERNED ON ANISOTROPIC SUBSTRATES USING POTENTIAL THEORY
S. S. Toncich, R. E. Collin (Case Western Reserve Univ., Cleveland, OH.), and K. B. Bhasin Feb. 1993 6 p Proposed for presentation at the Electrical and Electronics Engineers, MTT-S International Microwave Symposium, Atlanta, GA, 12-18 Jun. 1993; sponsored by the IEEE Microwave Theory and Techniques Society
(RTOP 506-72-1B)
(NASA-TM-106037; E-7608; NAS 1.15:106037) Avail: CASI HC A02/MF A01

A technique for a full wave characterization of microstrip open end discontinuities fabricated on uniaxial anisotropic substrates using potential theory is presented. The substrate to be analyzed is enclosed in a cutoff waveguide, with the anisotropic axis aligned perpendicular to the air-dielectric interface. A full description of the sources on the microstrip line is included with edge conditions built in. Extention to other discontinuities is discussed. Author

N93-20272# California Univ., Berkeley. Dept. of Materials Science and Mineral Engineering.
STRUCTURE AND RELIABILITY METAL CONTACTS TO GaAs Final Report, 1 Jun. 1986 - 31 Dec. 1991
Eicke R. Weber and Jack Washburn 31 Dec. 1991 43 p
(Contract N00014-86-K-0668)
(AD-A259184) Avail: CASI HC A03/MF A01

These results make it clear that any change in near-interfacial stoichiometry, e.g., by reaction of the metal overlayer with the substrate, will result in a change in barrier height and thus a change in the electrical performance of the device. Using electrical and microstructural characterization, we have investigated a wide range of metal/GaAs systems including the metals Ti, Al, Cr, Pd, and Au. The Fermi level pinning position is found to relate directly to the amount of excess As near the interface: very As-rich GaAs results in pinning near midgap and thus a low barrier height for n-GaAs; and less As-rich conditions result in pinning closer to the valence band and thus a high barrier height for n-GaAs. The observation was made by comparing near-interfacial stoichiometry of different metals with low and high barrier height, and by studying the change in near-interfacial stoichiometry upon annealing. GRA

N93-20307 Department of the Navy, Washington, DC.
SAFETY AND ARMING SYSTEM FOR TUBE LAUNCHED PROJECTILE Patent
Steven N. Chan, inventor (to Navy) 21 Jul. 1992 9 p Filed 13 Dec. 1991 Supersedes AD-D015202
(AD-D015557; US-Patent-Appl-SN-807020) Avail: US Patent and Trademark Office

An inertia element within a projectile is displaced to a retracted position by acceleration of the projectile during launch to unblock displacement of a slider to an armed position in response to subsequent pressurization of a projectile flight motor. Safe separation timers are thereby enabled in response to proper launch to delay pressurization of the flight motor and powering of an explosive firing circuit through switches actuated by said displacement of the slider from a safe position to the armed position. The slider is held in its safe position by an electrically grounded shear wire that is ruptured in response to slider displacement thereby removing a power disabling shunt connection to the firing circuit. GRA

N93-20309 Department of the Navy, Washington, DC.
CABLE CONNECTOR/ADAPTER SUPPORT FOR MULTI-TERMINAL DATA PROCESSORS Patent
David H. Nhu, inventor (to Navy) 14 Jul. 1992 7 p Filed 10 Sep. 1991
(AD-D015572; US-Patent-5,130,890; US-Patent-Appl-SN-758918) Avail: US Patent and Trademark Office

A support panel movably mounted on the cabinet of a multi-terminal data processor, carries retainers releasably holding cable connectors, disconnected from the processor terminals, in an orderly arrangement to protect the connectors from damage and facilitate proper plug in handling. GRA

N93-20328# Department of the Navy, Washington, DC.
AN EXTENDED LENGTH DIGITAL CORRELATOR THRESHOLD CIRCUIT Patent Application
Leon M. Leibowitz, inventor (to Navy) and T. Mai, inventor (to Navy) 30 Apr. 1992 24 p
(AD-D015610; US-Patent-Appl-SN-876151; Navy-Case-70118) Avail: CASI HC A03/MF A01

An extended length digital correlator threshold circuit for (N * M)-bit correlation using N M-bit correlators is disclosed. For the exemplary case where N=2, the digital correlator threshold circuit comprises: a first circuit for storing a preselected code word having first and second digital code portions; a first correlator responsive to the first digital code portion and an input digital data stream passing there through for periodically producing a first multibit number representative of the number of bit agreements between the bits in the digital data stream and the bits in the first digital code portion; a second correlator responsive to the second digital code portion and the digital data stream passing there through from the first correlator for periodically producing a second multibit number representative of the number of bit agreements between the bits in the digital data stream from the first correlator and the bits in the second digital code portion; and a second circuit responsive to said first and second multibit numbers for generating an output signal when the combined number of bit agreements in both of the first and second multibit numbers is at least equal to a preselected threshold number. GRA

N93-20395# Stanford Univ., CA.
ADVANCED UHV THIN-FILM DEPOSITION FACILITY FOR RESEARCH IN SUPERCONDUCTIVITY AND SUPERCONDUCTING ELECTRONICS Final Report
M. R. Beasley and R. H. Hammond 28 Oct. 1992 4 p
(Contracts N00014-84-G-0170; N00014-84-J-1170)
(AD-A259089) Avail: CASI HC A01/MF A01

The final report for the above grant describes an Advanced UHV Thin-Film Deposition Facility for Research in Superconductivity and Superconducting Electronics. A list of acquired equipment and a discussion of special circumstances regarding changes from the proposal and use of the

equipment also follows. The completed facility is in full use for research as described in the proposal, and in high Tc superconducting materials research, other oxide materials, and C60 Fullerene alloys. A new vapor synthesis process monitor and control techniques (Atomic Absorption Rate Control) was developed. GRA

N93-20396# Department of the Navy, Washington, DC.
AN ELECTROCATALYTIC CATHODE DEVICE AND A METHOD FOR MAKING SUCH A CATHODE Patent Application
Catherine L. Marsh, inventor (to Navy) 21 Aug. 1992 10 p
(AD-D015586; US-Patent-Appl-SN-931467; Navy-Case-73161) Avail: CASI HC A02/MF A01

An electrocatalytic cathode that will allow hydrogen peroxide, H2O2, to behave electrochemically within an Al-H2O2 battery system is provided. The electrocatalytic cathode is comprised of nickel specially coated with one or a combination of the following six metals: platinum, ruthenium, rhodium, osmium, palladium, and iridium. The use of nickel coated with the appropriate combination of metals reduces the problems of excessive peroxide decomposition, thereby producing a battery that can operate efficiently by producing a high voltage at a high current density. The electrocatalytic cathode is produced by pretreating a nickel electrode with a hydrochloric acid bath and then by applying the metal coating by plating methods. GRA

N93-20556# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
SIGNAL APPROXIMATION WITH A WAVELET NEURAL NETWORK M.S. Thesis
Charles M. Westphal Dec. 1992 57 p
(AD-A259081; AFIT/GE/ENG/92D-38) Avail: CASI HC A04/MF A01

The use of Wavelet Neural Networks (WNN) for signal approximation is investigated. The particular wavelet function used in this analysis consisted of a summation of sigmoidal functions (a sigmoidal wavelet). The sigmoidal wavelet has the advantage of being easily implemented in hardware via specialized electronic devices like the Intel Electronically Trainable Analog Neural Network (ETANN) chip. The WNN representation allows the determination of the number of hidden-layer nodes required to achieve a desired level of approximation accuracy. Results show that a bandlimited signal can be accurately approximated with a WNN trained with irregularly sampled data. GRA

N93-20562# Ohio State Univ., Columbus. Electroscience Lab.
JOINT SERVICES ELECTRONICS PROGRAM Annual Report No. 15
Leon Peters, Jr. Nov. 1992 47 p
(Contract N00014-89-J-1007)
(AD-A259179; Rept-721563-5) Avail: CASI HC A03/MF A01

The report represents the fifteenth annual summary of The Ohio State University Joint Services Electronics Program (JSEP). The transfer of the compact range identification technology initiated under JSEP support for time domain studies continues to make large advances. We are also assisting Rockwell (Tulsa) to update their RCS facilities. This work is on a subcontract to the ESL from the Air Force. This has lead to involvement in the study of Ultra Wide Band radar systems. The research activities devoted to the Generalized Ray and Gaussian Beams continues. Our JSEP research continues to be expanded by external funding. This program is being expanded by use of such funds which are more focussed on the requirements of the sponsors which includes both the Air Force and the Navy. Our JSEP research continues to focus on electromagnetic related topics. There are four major electromagnetics areas that were pursued in the past year. The Diffraction Studies Work Unit has initiated research on a time domain version of the Uniform Theory of Diffraction. A second topic under the Diffraction Studies Work Unit involves further extensions of the generalized resistive boundary condition and the generalized impedance boundary condition. These have been applied to scattering from a chiral slab. A third topic of interest is the diffraction from a corner. A fourth task involves the reflection/diffraction of a Gaussian beam. This represents an approach to replace the usual ray optics solution for very complex geometries where the versatile ray optics solution becomes cumbersome. GRA

N93-20572*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
STUDYING THE KINETICS OF MAGNETIZATION IN HIGH Tc SUPERCONDUCTORS Final Report
8 Feb. 1993 11 p
(Grant NAG5-1890)
(NASA-CR-192159; NAS 1.26:192159) Avail: CASI HC A03/MF A01

We report the first microscopic maps of magnetic induction in YBa2Cu3O(7-x) crystals which directly show the dependence of flux flow on twin density, polytwin block, and twin boundary orientation. These maps were obtained by means of a recently-improved magneto-optical imaging technique. Pinning was lowest in untwinned regions and increasing with increasing twin density. Anisotropy in twin boundary pinning, defined as the ratio of the magnetic induction gradient across twin boundaries to that along twin boundaries, was 10 at 17 K; this ratio increased with increasing temperature. In polycrystals, twin boundaries also had a strongly anisotropic effect on flux flow into a grain from a grain boundary. Derived from text

N93-20591# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
SILICON MICROMACHINING APPLIED TO THE MANAGEMENT OF THE THERMAL ENVIRONMENT IN WAFER SCALE INTEGRATION TECHNOLOGY M.S. Thesis
Paul E. Cook Dec. 1992 329 p
(AD-A259123; AFIT/GE/ENG/92D-12) Avail: CASI HC A15/MF A03

The purpose of this research was to evaluate the heat dissipation effectiveness of several silicon micromachined structures when applied to wafer scale integration modules. The thermal dissipation characteristics of four micromachined structures and two control surfaces were determined. The heat dissipation structures were incorporated into a wafer scale integration thermal module. The micromachined structures investigated include: randomly spaced and sized pyramids, deep-vertical-wall-grooves, V-grooves, and microfluid channels. This research effort found no evidence that the micromachined structures improved the thermal dissipation characteristics of the thermal modules when air (natural and forced) cooling was used. However, the presence of voids in the epoxy used to fabricate the deep-vertical-wall-groove and pyramid thermal modules significantly degraded their thermal dissipation performance. A significant decrease in the thermal resistance occurred when water cooling was used with the micro-fluid channel structures. GRA

N93-20751# Technische Univ., Berlin (Germany). Fachbereich Elektrotechnik.
REPRESENTATION AND READABILITY OF LOGIC DIAGRAMS AND ASPECTS OF THEIR AUTOMATIC GENERATION Ph.D. Thesis [DARTTELLUNG UND LESBARKEIT VON LOGIKPLAENEN UND ASPEKTE IHRER AUTOMATISCHEN ERTTELLUNG]
Ingolf Schroeder 1992 148 p In GERMAN
(ETN-93-92559) Avail: CASI HC A07/MF A02

Taking digital logic diagrams as examples, it is shown that the task of producing a graphic representation from a computational data base, in conformity with given boundary conditions, is fundamentally resolvable. It is shown, as a new result, that many equivalent solutions can be constructed which are subjected to the fundamental restrictions of a maximal complexity. The less elements, the greater the freedom of representation. These trends lead to boundary conditions which are to be imperatively taken into consideration for logic diagram generation. An example of more than 300 modules on about 4 sq m was realized. ESA

N93-20766 Department of the Navy, Washington, DC.
DIELECTRIC CONSTANT MEASUREMENT PROBE ASSEMBLY AND APPARATUS AND METHOD Patent
Michael M. Neel, inventor (to Navy) and Frank J. Schiavone, inventor (to Navy) 20 Oct. 1992 10 p Filed 30 Oct. 1990
(AD-D015537; US-Patent-5,157,337; US-Patent-Appl-SN-593727) Avail: US Patent and Trademark Office

A dielectric constant measurement probe assembly includes a coaxial cable having an outer electrical conductor and a center electrical conductor extending within the outer conductor and terminating at an end portion which projects beyond an end portion of the outer conductor. An adapter member has a central passage receiving the coaxial cable with the outer conductor of the cable extending through the passage of the adapter

member and projecting therefrom. An outer tube has a bore composed of first and second axial sections. The second bore section is smaller in diameter than the first bore section. The adapter member is inserted in the first bore section with the end portion of the coaxial cable outer conductor inserted into the second bore section and making electrical contact therewith such that the outer tube thus constitutes an extension of the outer conductor. A resonant rod is coupled with the end portion of the center conductor of the coaxial cable and an annular sleeve supports the resonant rod in the second bore section of the outer tube such that the rod constitutes an extension of the center conductor. The resonant rod and outer tube together define an open end of the coaxial cable such that the rod being capable of acting as a resonant structure upon energizing the coaxial cable produces fringing fields that protrude from the open end and penetrate a test sample disposed adjacent thereto. GRA

N93-20768 Department of the Navy, Washington, DC.
MICROCHANNEL ELECTRON SOURCE Patent
Kevin Boulais, inventor (to Navy) and Joon Choe, inventor (to Navy) 21 Jul. 1992 8 p Filed 4 Apr. 1991
(AD-D015555; US-Patent-5,132,586; US-Patent-Appl-SN-680864) Avail: US Patent and Trademark Office

A microchannel plate device utilizing a semiconducting bulk material is characterized by electron emissions of high output current density and efficiency. The channel passages in the plate device which are square in cross-section accommodates a larger open area ratio at the input and output plate surfaces. An extended range of high electron emission applications for the plate device is provided. Such applications may include a photocathode installation to which a modulation pulse input is applied under low voltages isolated from high post-accelerating voltages. GRA

N93-20783 Department of the Navy, Washington, DC.
HIGH POWER MICROWAVE GENERATOR Patent
Han S. Uhm, inventor (to Navy) and Khanh T. Nguyen, inventor (to Navy) 25 Aug. 1992 6 p Filed 14 Jan. 1992 Supersedes N92-29199 (30 -19, p 3277), AD-D015262
(AD-D015560; US-Patent-Appl-SN-819699; US-Patent-Class-331-83) Avail: US Patent and Trademark Office

Conversion of electron beam energy into high power microwave energy is effected within the cavity of a Klystron device to which the electron beam is accelerated from a continuous supply source through an ion focussing channel. Ion focussing is achieved by establishment of a preionized background plasma within the channel to modulate the current of the electron beam in response to wake field effects and cause bunching of the electron beam during propagation to the Klystron device. GRA

N93-20785 Department of the Navy, Washington, DC.
PRECISION DIGITAL PHASE LOCK LOOP CIRCUIT Patent
Kenneth L. Atwood, inventor (to Navy) and Peter K. Pae, inventor (to Navy) 20 Oct. 1992 10 p Filed 30 Aug. 1991
(AD-D015594; US-Patent-5,157,342; US-Patent-Appl-SN-752294) Avail: US Patent and Trademark Office

A digital PLL circuit has a serial shift register receiving input pulses and producing time-delayed output pulses, a clock generator applying clock pulses to the shift register to drive it and set the phase shift of the output pulses, and a digitally-controlled potentiometer connected in series with the clock generator and being adjustable to change its resistance in increments in order to adjust the resistance of the clock generator and thereby set the frequency of the clock pulses applied to the shift register and the time delay produced by the shift register. A feedback control arrangement receives the same digital input pulses as received by the shift register and detects the periods of the input pulses by counting to produce control pulses proportional to the detected periods. A ROM unit stores a lock-up table of values representing an array of different counts of increments by which the potentiometer resistance can be adjusted. The ROM unit can be accessed by input signals identifying different addresses thereof. The input signals are composed of the control pulses and other external pulses defining different desired phase shifts of the output pulses. GRA

N93-20792 Department of the Navy, Washington, DC.
PYRITE CATHODE MATERIAL FOR A THERMAL BATTERY Patent
J. P. Pemsler, inventor (to Navy) and John K. Litchfield, inventor (to Navy) 29 Sep. 1992 4 p Filed 7 Feb. 1991 Supersedes N91-29475 (29 - 21, p 3508), AD-D014945
(AD-D015600; US-Patent-5,151,262; US-Patent-Appl-SN-652156; US-Patent-Class-423-561.1) Avail: US Patent and Trademark Office

High purity synthetic pyrite is produced in a two-step and also in a one-step sulfidation reaction of iron powder. In a two-step process, a hydrogen-annealed iron powder is first reacted with molten sulfur at a temperature of from about 200 - 455 C, while subjecting the reaction mass to mixing for a period sufficient to convert the iron powder to pyrrhotite, which is then reacted in a second step with sulfur vapor at a temperature of from about 420 - 550 C, while subjecting the reaction mass to mixing for a period sufficient to convert the pyrrhotite to substantially pure pyrite. In a one-step process, iron powder is gradually heated from room temperature to about 550 C in the presence of sulfur while continuously mixing to prevent sintering and agglomeration. GRA

N93-20799 Department of the Navy, Washington, DC.
APPARATUS AND METHOD FOR NON-CONTACT SURFACE VOLTAGE PROBING BY SCANNING PHOTOELECTRON EMISSION Patent
Larry D. Flesner, inventor (to Navy) 22 Sep. 1992 5 p Filed 11 Feb. 1991
(AD-D015583; US-Patent-5,150,043; US-Patent-Appl-SN-653829) Avail: US Patent and Trademark Office

An apparatus and method for non-contact sensing electrical potentials of selected regions on the surface of a sample are provided. A typical sample is an integrated circuit, electronic device, or semiconductor material. The sample is positioned within a vacuum chamber and irradiated with an ultraviolet light beam so that the material emits electrons by the photoelectric effect. The electrons have kinetic energies which are variable according to the electrical potential of the surface of the material. Emitted electrons having kinetic energies within a predetermined range are selected by an electron energy analyzer. An electron detector receives the selected electrons and produces electrical signals corresponding to the energies of said selected electrons. In another embodiment of the invention, a modulated light beam other than the ultraviolet light probe beam irradiates the material in order to produce time varying modulation of the photoelectron energy spectrum. GRA

N93-20841# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).
STRUCTURAL EQUILIBRATION IN INTRINSIC, SINGLE-DOPED, AND COMPENSATED TFT'S: EXPERIMENTS AND CALCULATIONS
Gerhard Kroetz and Gerhard Mueller 1991 5 p Repr. from Journal of Non-Crystalline Solids, v. 137-138, 1991 p 163-166 Presented at the 14th ICAS, Garmisch-Partenkirchen, Germany, 19-23 Aug. 1991 Sponsored by Technische Univ.
(MBB-Z-0377-91-PUB; ETN-92-92751) Avail: CASI HC A01/MF A01

Bias annealing experiments were performed in intrinsic, single doped and compensated amorphous Si:H specimens arranged in a field effect geometry. In doped Thin Film Transistors (TFT) structures pronounced shifts in the transfer characteristics were observed. Compensated TFT's could be reversibly switched between n and p conducting states. TFT's with undoped active layer exhibited comparatively small effects. All effects arise from structural changes within the space charge region of the individual semiconductor layers. Model calculations, based on a generalized version of Street's autocompensation model of doping, provide quantitative support for this interpretation. ESA

N93-20878# Technische Univ., Berlin (Germany). Fachbereich Elektrotechnik.
THE IGNITION DIFFUSION CONCERNING CONTACTED AND NON CONTACTED n(+) EMITTER INTERRRUPTIONS Ph.D. Thesis [DIE ZUENDAUSBREITUNG AN KONTAKTIERTEN UND UNKONTAKTIERTEN N(+)-EMITTERUNTERBRECHUNGEN IN THYRISTOREN]
Dirk Hoheisel 1992 160 p In GERMAN
(ETN-93-92564) Avail: CASI HC A08/MF A02

Rod shaped thyristor specimens were examined with various emitter short circuits. A definition is given of two units, the critical current density and the flashover time, which were introduced to describe the effect of n(+) emitter interruptions. The mechanism of ignition diffusion in the vicinity of a short circuit point is considered. The examinations were carried out at a temperature range from minus 50 to 100 C. The measurement results were evaluated using a two dimensional analytical model. ESA

N93-20882# Technische Univ., Berlin (Germany). Fachbereich Elektrotechnik.

CMOS CIRCUIT TECHNIQUE FOR INTEGRATED VITERBI DECODERS Ph.D. Thesis [CMOS-SCHALTUNGSTECHNIK FUER INTEGRIERTE VITERBI-DECODER]

Harald Kapp 1992 176 p In GERMAN

(ETN-93-92568) Avail: CASI HC A09/MF A02

The realization of the Viterbi algorithm in integrated decoders for convolution codes is presented. Various types of number systems and various circuit techniques are examined for the addition and the comparison, with regard to their suitability for a Viterbi decoder. The reciprocal value of the product from chip surface and computing time is used as figure of merit. The result is that the dual code is optimal for use in a Viterbi decoder. The number representation allows the construction of very fast adders. A new process, the 'preadder of the metrics,' is presented for the acceleration of the Add Compare Select (ACS) units. Modules are developed, which can be used as standard cells within a semi-custom design, or as self suffficient chips. ESA

N93-20910*# Old Dominion Univ., Norfolk, VA. Dept. of Electrical and Computer Engineering.

A NEW METHOD FOR RECOGNIZING QUADRIC SURFACES FROM RANGE DATA AND ITS APPLICATION TO TELEROBOTICS AND AUTOMATION Progress Report, period ending 28 Feb. 1993

Nicolas Alvertos and Ivan DCunha Mar. 1993 246 p

(Grant NAG1-1223)

(NASA-CR-192619; NAS 1.26:192619) Avail: CASI HC A11/MF A03

The problem of recognizing and positioning of objects in three-dimensional space is important for robotics and navigation applications. In recent years, digital range data, also referred to as range images or depth maps, have been available for the analysis of three-dimensional objects owing to the development of several active range finding techniques. The distinct advantage of range images is the explicitness of the surface information available. Many industrial and navigational robotics tasks will be more easily accomplished if such explicit information can be efficiently interpreted. In this research, a new technique based on analytic geometry for the recognition and description of three-dimensional quadric surfaces from range images is presented. Beginning with the explicit representation of quadrics, a set of ten coefficients are determined for various three-dimensional surfaces. For each quadric surface, a unique set of two-dimensional curves which serve as a feature set is obtained from the various angles at which the object is intersected with a plane. Based on a discriminant method, each of the curves is classified as a parabola, circle, ellipse, hyperbola, or a line. Each quadric surface is shown to be uniquely characterized by a set of these two-dimensional curves, thus allowing discrimination from the others. Before the recognition process can be implemented, the range data have to undergo a set of pre-processing operations, thereby making it more presentable to classification algorithms. One such pre-processing step is to study the effect of median filtering on raw range images. Utilizing a variety of surface curvature techniques, reliable sets of image data that approximate the shape of a quadric surface are determined. Since the initial orientation of the surfaces is unknown, a new technique is developed wherein all the rotation parameters are determined and subsequently eliminated. This approach enables us to position the quadric surfaces in a desired coordinate system. Experiments were conducted on raw range images of spheres, cylinders, and cones. Experiments were also performed on simulated data for surfaces such as hyperboloids of one and two sheets, elliptical and hyperbolic paraboloids, elliptical and hyperbolic cylinders, ellipsoids and the quadric cones. Both the real and simulated data yielded excellent results. Our approach is found to be more accurate and computationally inexpensive as compared to traditional approaches, such as the three-dimensional discriminant approach which involves evaluation of the rank of a matrix. Finally, we have proposed one other new approach, which involves the formulation of a mapping between the explicit and implicit forms of representing quadric surfaces. This approach, when fully realized, will yield a three-dimensional discriminant, which will recognize quadric surfaces based upon their component surfaces patches. This approach is faster than prior approaches and at the same time is invariant to pose and orientation of the surfaces in three-dimensional space. Author

N93-20935# Technische Univ., Eindhoven (Netherlands).

MAGNETIC SWITCHING TECHNIQUES FOR HIGH POWER PULSE GENERATION Ph.D. Thesis

Aart Louis Keet 1992 127 p

(ISBN-90-9004705-0; ETN-93-93064) Avail: CASI HC A07/MF A02

Since reliable generation of high power pulse with high efficiency makes a reintroduction of the magnetic switches desirable, experiments to demonstrate the possibility of using solid state switches (thyristors) in conjunction with magnetic pulse compression techniques in high power pulse generators were performed. Principles of magnetic switches and pulse transformers were considered and theoretical and experimental results are presented. Since magnetic materials have a great influence on magnetic switches, some materials with their parameters are discussed. Different types of magnetic pulse compression circuits for high repetition rate pulsers are shown. The advantages and disadvantages of the different types of circuits are discussed. The new circuit for excimer lasers Magnetic Induced Resonant Voltage Overshoot Circuit (MIRVOC) is shown. This circuit can operate with high efficiency, in combination with an excimer laser, in view of the special load impedance characteristics. ESA

N93-21006# Ecole Centrale de Lyon (France). Lab. d'Electronique d'Automatique et de Mesures Electriques.

CONTRIBUTION TO THE DEVELOPMENT OF AN ISFET TYPE INTEGRATED SENSOR USING AN ASIC THREAD IN CMOS TECHNOLOGY Ph.D. Thesis [CONTRIBUTION AU DEVELOPPEMENT D'UN CAPTEUR INTEGRE DE TYPE ISFET A PARTIR D'UNE FILIERE ASIC EN TECHNOLOGIE CMOS]

Kwami Dzahini 1991 174 p In FRENCH

(ECL-91-09; ETN-93-91949) Avail: CASI HC A08/MF A02

CMOS technology and the principal of MOS transistor based sensors are reviewed. The compatibility between ISFET grafting and CMOS technology is investigated. Operational principles of ISFET sensors and their polarization are addressed, and integrated circuits developed for the integration of a polarization and measurement system are presented. Specific structures developed for components used in CMOS analog circuits are detailed. A program developed for the automization of CMOS analog circuit masks is described. Results obtained for sensors based on the piezotransistor effect in CMOS technology are presented in annex; this type of sensor was studied in parallel with the ISFETs. Mechanical difficulties limiting the study are shown. ESA

N93-21008# Universiteit Twente, Enschede (Netherlands). Dept. of Applied Mathematics.

THE EFFECTIVE TRANSVERSE RESISTIVITY IN MULTIFILAMENTARY CONDUCTORS

E. M. J. Niessen and R. M. J. vanDamme Jan. 1992 19 p

(Memo-1027; ETN-93-92455) Avail: CASI HC A03/MF A01

The isotropic coarse grained electric conductivity sigma(perpendicular) of normal conducting matrix material surrounding nonconducting hexagonal filaments in a sixfold rotational symmetry is calculated using two methods. The analytical method is based on solving the Laplace equation with a conformal mapping method using the Schwarz-Christoffel transformation. The numerical method consists of solving partial differential equations describing the solenoidal and irrotational electric field using a finite difference method. Good agreement is found between results obtained using both methods. The maximal discrepancy between the values stated by Carr, where sigma(perpendicular) is a geometry independent linear function of the ratio between the conducting volume and the total plus nonconducting volume, and the calculated values is about 2 percent near eta = 0.5, with eta being the nonconducting volume fraction. The values obtained by Carr are too high in the whole eta range. ESA

N93-21021# Technische Univ., Berlin (Germany). Fachbereich Informatik.

GGADS: A LIBRARY INDEPENDENT LAYOUT SYNTHESIS SYSTEM FOR USER ADAPTIVE GATE ARRAY MASTER STRUCTURES Ph.D. Thesis [GGADS: EIN BIBLIOTHEKSUNABHAENGIGES LAYOUTSYNTHESESYSTEM FUER BENUTZERDEFINIERBARE GATE-ARRAY-MASTER-STRUKTUREN]

Achim Hoffmann 1992 134 p In GERMAN

(ETN-93-92571) Avail: CASI HC A07/MF A02

The General Gate Array Design System (GGADS) is presented. The

system produces the wiring masks for the user free adaptive data array master structures from a description of the main geometries and of the circuit. GGADS itself produces the required elementary wirings and can be used at low cost for new master structures. In GGADS, the new algorithm SQP (Simultaneous Quadri Partitioning), is used for the global placement. For local placement, GGADS follows a constructive arrangement which is implemented as a new concept. The layouts produced with GGADS show that a further algorithm refinement represents a significant alternative to the existing design projects. The efficiency of GGADS was compared with the efficiency of the best commercial systems, such as TANGATE. TANGATE showed a 20 percent better yield. ESA

N93-21194# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Product Assurance and Safety Dept.

DERATING REQUIREMENTS APPLICABLE TO ELECTRONIC, ELECTRICAL, AND ELECTRO-MECHANICAL COMPONENTS FOR ESA SPACE SYSTEMS

Apr. 1992 34 p

(ESA-PSS-01-301-Issue-2; ETN-93-93510) Copyright Avail: CASI HC A03/MF A01

Derating requirements for electronic, electrical, and electromechanical components used in equipment for use on ESA spacecraft are presented. Suitable derating is decided on the analyses described. Tables contain: the derating to be applied to specified component parameters; the parameter degradations to be used for worst case analysis; and notes to the tables containing application rules for the components. Data is not supplied for radiation effects analysis as this varies widely and must be considered on a case by case basis. ESA

N93-21250# Department of the Navy, Washington, DC.

REGULATABLE FIELD EMITTER DEVICE AND METHOD OF PRODUCTION THEREOF Patent Application

Henry F. Gray, inventor (to Navy) 30 Jul. 1992 47 p

(AD-D015614; US-Patent-Appl-SN-921658; Navy-Case-73111) Avail: CASI HC A03/MF A01

A voltage controlled current source such as a field effect transistor is provided to output a regulated current in dependence upon a control voltage. An electron field emitter is connected to a drain or output of the voltage controlled current source to receive the regulated current. A tip of the electron field emitter emits electrons towards a collector anode. An extractor gate can be provided between the electron field emitter and the collector anode to control the rate of electron emission from the electron field emitter. Because the voltage controlled current source regulates the current to the electron field emitter, a maximum current output of the electron field emitter is limited to the regulated current from the voltage controlled current source. The electron field emitter is thus protected from destruction due to excess current. The voltage controlled current source can also be used to modulate electron emission from the field emitter. GRA

N93-21256# National Inst. of Standards and Technology, Gaithersburg, MD. Semiconductor Electronics Div.

ELECTRONICS AND ELECTRICAL ENGINEERING LABORATORY TECHNICAL PUBLICATIONS ANNOUNCEMENTS COVERING LABORATORY PROGRAMS, JANUARY TO MARCH 1992, WITH 1992/1993 EEEL EVENTS CALENDAR

J. A. Gonzalez, comp. Oct. 1992 21 p

(PB93-120715; NISTIR-4945) Avail: CASI HC A03/MF A01

This is the 32nd issue of a quarterly publication providing information on the technical work of the National Institute of Standards and Technology Electronics and Electrical Engineering Laboratory (EEEL). This issue of the EEEL Technical Publication Announcements covers the first quarter of calendar year 1992. This issue contains citations and abstracts for Laboratory publications published in the quarter. Major subject headings include the following: Fundamental Electrical Measurements; Semiconductor Microelectronics; Signal Acquisition, Processing, and Transmission; Electrical Systems; and Electromagnetic Interference. GRA

N93-21257# National Inst. of Standards and Technology, Gaithersburg, MD. Semiconductor Electronics Div.

ELECTRONICS AND ELECTRICAL ENGINEERING LABORATORY TECHNICAL PUBLICATIONS ANNOUNCEMENTS COVERING LABORATORY PROGRAMS, OCTOBER TO DECEMBER 1991, WITH 1992/1993 EEEL EVENTS CALENDAR

J. A. Gonzalez, comp. Sep. 1992 34 p

(PB93-120723; NISTIR-4929) Avail: CASI HC A03/MF A01

This is the 31st issue of a quarterly publication providing information on the technical work of the National Institute of Standards and Technology Electronics and Engineering Laboratory (EEEL) (until February 1991, the Center for Electronics and Electrical Engineering). This issue of the EEEL Technical Publication Announcements covers the fourth quarter of calendar year 1991. This issue contains citations and abstracts for Laboratory publications published in the quarter. Major subject headings include the following: Microelectronics; Signal Acquisition, Processing, and Transmission; Electrical Systems; and Electromagnetic Interference. GRA

N93-21309*# Rensselaer Polytechnic Inst., Troy, NY. Center for Intelligent Robotic Systems for Space Exploration.

THE M68HC11 GRIPPER CONTROLLER ELECTRONICS

Robert B. Kelley and Jeffrey Bethel Jun. 1991 71 p

(Grant NAGw-1333)

(NASA-CR-192732; NAS 1.26:192732; RPI-CIRSSE-92) Avail: CASI HC A04/MF A01

This document describes the instrumentation, operational theory, circuit implementation, calibration procedures, and general notes for the CIRSSE general purpose pneumatic hand. The mechanical design and the control software are discussed. The circuit design, PCB layout, hand instrumentation, and controller construction described in detail in this document are the result of a senior project. Author (revised)

N93-21350# Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.

THE EFFECTS OF IONIZING AND PARTICLE RADIATION ON PRECISION FREQUENCY SOURCES (PROPOSAL FOR IEEE STANDARDS PROJECT P1193)

Joseph J. Suter, Richard H. Maurer, James D. Kinnison, Raymond Besson (Ecole Nationale Superieure de Mecanique et des Microtechniques, Besancon, France.), John R. Vig (Army Lab. Command, Fort Monmouth, NJ.), and Andy Koehler (Harvard Univ., Cambridge, MA.) 4 Jul. 1992 74 p

(Contract N00039-91-C-0001)

(PB92-227073; JHU/APL/SDO-9865) Avail: CASI HC A04/MF A01

The susceptibility of quartz oscillators and atomic frequency standards to natural and enhanced ionizing and particle radiation is an important parameter in predicting the short and long term performances of these standards in spacecraft. Characterization of the response of frequency standards to ionizing and particle radiation should be based on a thorough understanding of the radiation environment (proton, electron, neutron and flash x-ray radiation, and single event upset) and radiation scenarios (dose/anneal cycle, combined environments). The document will present, in detail, the various forms of radiation existing or produced in the low-earth orbit and enhanced environments. In particular, emphasis will be placed on flux, fluence, and dose rate levels and interaction mechanisms as pertaining to realistic radiation exposure scenarios. In addition to a discussion of radiation environments (proton, electron, neutron, flash x-ray, gamma, and single event upset), selection criteria for radiation sources are presented including dosimetry and procedures for the radiation testing of frequency standards. GRA

N93-21377# Environmental Protection Agency, Ann Arbor, MI. Technology Development Group.

EVALUATION OF A SCHATZ HEAT BATTERY ON A FLEXIBLE-FUELED VEHICLE. PHASE 2

Gregory K. Piotrowski and Ronald M. Schaefer Jun. 1992 50 p

(PB92-204585; EPA/AA/TDG-92/03) Avail: CASI HC A03/MF A01

The report describes the evaluation of a Schatz Heat Battery as a means of reducing cold start emissions from a vehicle fueled alternately with indolene clear and M85 high methanol blend fuels. The evaluation was conducted at both 20 and 75 F ambient temperature. The report includes a description of the Schatz Heat Battery, the test vehicle, test facilities, test procedures, and a discussion of the test results. GRA

N93-21559*# University of Eastern Kentucky, Richmond. Dept. of Physics.
THE RESONATOR HANDBOOK Final Report
Jerry D. Cook and Shiliang Zhou [1993] 53 p
(Grant NAG3-1343)
(NASA-CR-192217; NAS 1.26:192217) Avail: CASI HC A04/MF A01

The purpose of this work is to extend resonator theory into the region in which the planar mirror is quite small. Results of the theoretical description are then extended to resonator design and experimental arrangements as discussed in further sections of this work. Finally, a discussion of dielectric measurements for small samples is included as a specific application of this work. Author

N93-21724# Allied-Signal Aerospace Co., Kansas City, MO.
ELECTROMAGNETIC FINITE ELEMENT ANALYSIS OF A SOLENOID
D. R. Hahn Nov. 1992 12 p
(Contract DE-AC04-76DP-00613)
(DE93-004635; KCP-613-4826) Avail: CASI HC A03/MF A01

An electromagnetic finite element study was performed on a solenoid. Flux density distributions were obtained for seven rotor positions at five-degree increments. Co-magnetic energies were computed at each position for applied coil currents of 290 and 500 milliamperes and were used to generate torque-position curves. DOE

N93-21725# Allied-Signal Aerospace Co., Kansas City, MO.
MICROELECTRONICS PACKAGING AUTOMATION
R. J. Blazek Nov. 1992 13 p
(Contract DE-AC04-76DP-00613)
(DE93-004822; KCP-613-4968) Avail: CASI HC A03/MF A01

Microelectronic packaging evaluations were completed that established process capabilities for wire bond testing data analysis, eutectic die attach, and hermetic sealing. These processes are used for chip and wire hybrid microcircuits (HMC's), leadless chip carriers (LCC's), and large-scale integrated circuits (LSI's) manufactured at the Kansas City Division. DOE

N93-21727# Allied-Signal Aerospace Co., Kansas City, MO.
VACUUM MULTILAYER LAMINATION OF PRINTED WIRING BOARDS
J. W. Wilkus Nov. 1992 119 p
(Contract DE-AC04-76DP-00613)
(DE93-004912; KCP-613-4865) Avail: CASI HC A06/MF A02

This experiment investigates vacuum multilayer lamination of rigid/flex, epoxy glass, polyimide glass, and polyimide quartz printed wiring boards. The effectiveness of the vacuum in removing entrapped air during the lamination cycle is demonstrated. The results of the experiment have also shown that vacuum lamination of epoxy glass multilayers improves the delamination resistance. Thus, epoxy glass multilayers that have been vacuum laminated will be able to withstand soldering temperatures longer without delaminating. Also, the experiment shows that vacuum multilayer lamination does not significantly change thickness, layer-to-layer registration, glass transition temperature, dielectric spacing between conductors, electrical resistance following thermal shock test, and other critical printed wiring board properties. DOE

N93-21733# Oak Ridge National Lab., TN.
DESIGN AND CHARACTERIZATION OF THE BVX: AN 8-CHANNEL CMOS PREAMPLIFIER-SHAPER FOR SILICON STRIPS
C. L. Britton, Jr., G. T. Alley, M. L. Simpson, A. L. Wintenberg, R. J. Yarema, T. Zimmerman, J. Boissevain, W. Collier, B. V. Jacak, and J. Simon-Gillo 1992 4 p Presented at the Nuclear Science Symposium, Orlando, FL, 26-31 Oct. 1992
(Contract DE-AC05-84OR-21400)
(DE93-003619; CONF-921005-5) Avail: CASI HC A01/MF A01

This paper presents the design and characterization of an 8 channel preamplifier-shaper intended for use with silicon strip detectors ranging in capacitance from 1 to 20 pF. The nominal peaking time of the circuit is 200 ns with an adjustment range of +/- 50 ns. The circuit has a pitch (width) of 84 microns/channel with a power dissipation of 1.2 mW/channel and has been fabricated in 2 micron p-well CMOS. The 0 pF noise is 330 e with a noise slope of 64 e/pF. The design approach is presented as well as both test bench and strip detector measurements. DOE

N93-21768# Sandia National Labs., Albuquerque, NM.
ANALYSIS OF PARAMETRIC DRIFT OF A MESFET-BASED GaAs MMIC DUE TO 125 C STORAGE
P. L. Dreike, D. L. Barton, and C. E. Sandoval 1992 3 p Presented at the International Reliability Physics Conference, Atlanta, GA, 22-25 Mar. 1993
(Contract DE-AC04-76DP-00789)
(DE93-000715; SAND-92-2073C; CONF-930354-1) Avail: CASI HC A01/MF A01

Microwave parameters drifted significantly for two out of twenty-nine GaAs MESFET-based MMIC's during ten weeks of storage at 125 and 150 C. Analysis using measured, post- storage, FET characteristics and the microwave behavior indicates that all of the FET's in the MMIC's drifted, most likely due to contamination. DOE

N93-21980# Brookhaven National Lab., Upton, NY.
MONOLITHIC PREAMPLIFIER EMPLOYING EPITAXIAL N-CHANNEL JFETS
V. Radeka, S. Rescia, P. F. Manfredi (Pavia Univ., Italy.), V. Re (Pavia Univ., Italy.), and V. Speziali (Pavia Univ., Italy.) Feb. 1992 14 p Presented at the 6th European Symposium on Semiconductor Detectors: New Developments on Radiation Detectors, Milan, Italy, 24-26 Feb. 1992
(Contract DE-AC02-76CH-00016)
(DE93-002951; BNL-48005; CONF-9202140-1) Avail: CASI HC A03/MF A01

This paper reports the results obtained in the research program oriented to the realization of a monolithic preamplifier for calorimetry applications in high luminosity colliders. The main purpose of the program is to arrive at a monolithic realization with a performance as close as possible to that of discrete preamplifiers. The junction field-effect transistors (JFET's) employed in discrete preamplifiers have an epitaxial channel and a very heavily doped gate diffused onto it. They present the best noise and radiation tolerance characteristics. The first step in the program implementation was, accordingly, the search for a process able to make the integration of epitaxial-channel JFET's on a monolithic substrate possible. The integration has been accomplished on the basis of a buried-layer approach to device isolation. Individual JFETs and a complete preamplifier employing only N-channel JFETs have been realized. The characterization of the individual devices has shown that their behavior in terms of small signal and noise parameters is very close to that of their discrete equivalents. This result, along with the very good noise performance of the preamplifier, seems to point out that the buried layer process has fulfilled the task for which it was developed. DOE

N93-20435# National Space Development Agency, Ibaraki (Japan). Common Equipment Lab.
DEVELOPMENT OF SATELLITE BORNE NICKEL HYDROGEN BATTERY EXPERIMENT EQUIPMENT FOR ETS-6 [ETS-6 YOU NIKKERU SUISO BATTERI TOUSAI JIKKEN KIKI NO KAIHATSU]
Saburou Kuwashima, Norimitsu Kamimori, Hiroaki Kusawake, and Kazumichi Takahashi *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 121-124 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20441# National Space Development Agency, Ibaraki (Japan). Total System Analysis Lab.
RESEARCH ON SPACE SUPERCONDUCTING ELEMENT TECHNOLOGY [UCHUUYOU CHOUDENDOU YOUSO GIJUTSU NO KENKYUU]
Toshio Douura, Atsuo Tsuiki, and Satoshi Nagano *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 145-148 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20456# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.
DEVELOPMENT OF HIGH HEAT RADIATION PRINTED BOARDS Report No. 2 [KOUHOUNETSU PURINTOBAN NO KAIHATSU]
Shigeo Shiota, Masahiro Nakao, Tooru Kanno, and Akira Shimizu *In its* Research and Development Activities of the Tsukuba Space Center Aug.

1992 p 209-212 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20457# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.
REVIEW ON ALUMINUM ELECTROLYTIC CONDENSERS DEVELOPMENT Report No. 3 [ARUMI DENKAI KONDENSA NO KAIHATSU KENTOU]
Shigeo Shiota, Masahiro Nakao, Muneaki Nakai, and Akira Shimizu *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 213-216 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20458# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.
IMPROVEMENT OF LC FEEDTHROUGH FILTERS Report No. 1 [LC KANTSUUGATA FIRUTA NO KAIRYOU]
Shigeo Shiota, Masahiro Nakao, and Akira Shimizu *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 217-220 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20459# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.
REVIEW ON SURFACE MOUNTING COMPONENTS (WIRE WOUND CHIP RESISTORS) DEVELOPMENT [HYOUMEN JISSOU BUHIN (MAKISEN CHIPPU TEIKOU) NO KAIHATSU KENTOU]
Shigeo Shiota, Masahiro Nakao, and Akira Shimizu *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 221-224 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20460# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.
DEVELOPMENT OF TRANSISTORS (EQUIVALENT TO 2SC3321) [TORANJISUTA (2SC3321 SOUTOU) NO KAIHATSU]
Sumio Matsuda, Takashi Tamura, and Masato Uesugi *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 225-226 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20461# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.
DEVELOPMENT OF POWER MOSFET (150 W CLASS) Interim Report [PAWA MOSFET (150 WATTO KURASU) NO KAIHATSU]
Satoshi Kuboyama, Takashi Tamura, Masato Uesugi, and Tooru Kanno *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 227-228 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20462# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.
IMPROVEMENT OF VOLTAGE REFERENCE ZENER DIODE (1SZ48A) [DENATSU HYOUJUN TSENADAIODO (1SZ48A) NO KAIRYOU]
Takashi Tamura, Masato Uesugi, and Masato Nakajima *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 229-234 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A02/MF A03

N93-20463# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.
DEVELOPMENT OF HIGH SPEED RECTIFIER DIODES Interim Report [KOUSOKU SEIRYUU DAIODO NO KAIHATSU]
Takashi Tamura, Masato Uesugi, and Masato Nakajima *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 235-238 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20464# National Space Development Agency, Tokyo (Japan). Parts and Material Management Office.
REVIEW ON SCHOTTKY BARRIER DIODE DEVELOPMENT [SHOTTOKI BARIA DAIODO NO KAIHATSU KENTOU]
Satoshi Kuboyama, Takashi Tamura (National Space Development Agency, Ibaraki, Japan.), and Mitsuhiro Nakamura (National Space Development Agency, Ibaraki, Japan.) *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 239-242 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20466# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.
REVIEW ON UPGRADING EFFICIENCY OF SILICON SOLAR BATTERY CELLS Report No. 1 [SHIRIKON TAIYOU DENCHI SERU NO KOUKOURITSUKA NO KENTOU]
Sumio Matsuda, Takashi Tamura, and Masato Uesugi *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 247-248 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20467# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.
DEVELOPMENT OF RADIATION RESISTANT HCMOSIC Interim Report [TAIHOUSHASENSEI HCMOSIC NO KAIHATSU]
Masato Nakajima, Takashi Tamura, Masato Uesugi, and Satoshi Kuboyama (National Space Development Agency, Tokyo, Japan.) *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 249-252 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20468# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.
DEVELOPMENT OF RADIATION RESISTANT LINEAR IC (EQUIVALENT TO MU PC 806) [TAIHOUSHASENSEI RINIA IC (MYU PC 806 SOUTOU) NO KAIHATSU]
Masato Nakajima, Takashi Tamura, Masato Uesugi, and Satoshi Kuboyama (National Space Development Agency, Tokyo, Japan.) *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 253-256 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20469# National Space Development Agency, Tokyo (Japan). Parts and Material Management Office.
DEVELOPMENT OF HIGH DENSITY HYBRID IC Interim Report [KOUMITSUDO HAIBURIDDO IC NO KAIHATSU]
Satoshi Kuboyama, Takashi Tamura (National Space Development Agency, Ibaraki, Japan.), Masato Uesugi (National Space Development Agency, Ibaraki, Japan.), and Jirou Aoki (National Space Development Agency, Ibaraki, Japan.) *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 257-258 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20470# National Space Development Agency, Tokyo (Japan). Parts and Material Management Office.
DEVELOPMENT OF 256 KBIT PROM Interim Report [256 KIRO BITTO PROM NO KAIHATSU]
Satoshi Kuboyama, Takashi Tamura (National Space Development Agency, Ibaraki, Japan.), Masato Uesugi (National Space Development Agency, Ibaraki, Japan.), and Tooru Kanno (National Space Development Agency, Ibaraki, Japan.) *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 259-260 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20471# National Space Development Agency, Tokyo (Japan). Parts and Material Management Office.
DEVELOPMENT OF 256 KBIT SRAM Interim Report [256 KIRO BITTO SRAM NO KAIHATSU]
Satoshi Kuboyama, Takashi Tamura (National Space Development Agency, Ibaraki, Japan.), and Mitsuhiro Nakamura (National Space Development Agency, Ibaraki, Japan.) *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 261-264 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20472# National Space Development Agency, Tokyo (Japan). Parts and Material Management Office.
DEVELOPMENT OF 10 k GATE-GATE ARRAY Report No. 1 [10 KIRO GETO GETO AREI NO KAIHATSU]
Satoshi Kuboyama, Sumio Matsuda (National Space Development Agency, Ibaraki, Japan.), and Yasuhiro Aikawa (National Space Development Agency, Ibaraki, Japan.) *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 265-266 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20473# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.
DEVELOPMENT OF 32 BIT MPU Interim Report [32 BITTO MPU NO KAIHATSU]
Masato Nakajima, Takashi Tamura, Masato Uesugi, and Satoshi Kuboyama (National Space Development Agency, Tokyo, Japan.) *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 267-270 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20474# National Space Development Agency, Tokyo (Japan). Parts and Material Management Office.
REVIEW ON RADIATION RESISTANT 32 BIT MPU Report No. 2 [TAIHOUSHASENSEI 32 BITTO MPU NO KENTOU]
Satoshi Kuboyama, Takashi Tamura (National Space Development Agency, Ibaraki, Japan.), and Mitsuhiro Nakamura (National Space Development Agency, Ibaraki, Japan.) *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 271-278 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A02/MF A03

N93-20476# National Space Development Agency, Ibaraki (Japan). Common Equipment Lab.
RESEARCH ON LARGE CAPACITY Ni-Cd BATTERIES [DAIYOURYOU NI-CD BATTERI NO KENKYUU]
Saburou Kuwashima, Norimitsu Kamimori, Kazuhiro Uchiyama, and Hiroaki Kusawake *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 285-288 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20477# National Space Development Agency, Ibaraki (Japan). Common Equipment Lab.
RESEARCH ON Ni-H2 BATTERIES [NI-H2 BATTERI NO KENKYUU]
Saburou Kuwashima, Norimitsu Kamimori, and Kazumichi Takahashi *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 289-292 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20478# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.
ESTABLISHMENT OF HIGH DENSITY INSTALLATION TECHNOLOGY Report No. 2 [KOUMITSUDO JISSOU GIJUTSU NO KAKURITSU]
Shigeo Shiota, Masahiro Nakao, Muneaki Nakai, and Akira Shimizu *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 293-296 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20481# National Space Development Agency, Tokyo (Japan). Parts and Material Management Office.
INDUSTRIAL IC EVALUATION TEST: 256 KBIT EEPROM [MINSEIHIN IC NO HYOUKA SHIKEN: 256 KIRO BITTO EEPROM]
Satoshi Kuboyama and Tooru Kanno (National Space Development Agency, Ibaraki, Japan.) *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 303-306 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20482# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.
RADIATION RESISTANCE EVALUATION TEST ON PARTS AND MATERIALS: SOLAR BATTERY CELL [BUHIN ZAIRYOU NO TAIHOUSHASEN HYOUKA: TAIYOU DENCHI SERU]
Sumio Matsuda, Takashi Tamura, and Masato Uesugi *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 307-308 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20483# National Space Development Agency, Tokyo (Japan). Parts and Material Management Office.
RESEARCH ON SINGLE EVENT RESISTANCE EVALUATION TECHNOLOGY: RESEARCH BY HEAVY ION IRRADIATION [SHINGURU IBENTO TAISEI NO HYOUKA GIJUTSU NO KENKYUU: JYUURYUUSHI ION SHOUSHA NI YORU KENKYUU]
Satoshi Kuboyama, Takashi Tamura (National Space Development Agency, Ibaraki, Japan.), Yousuke Shimano (National Space Development Agency, Ibaraki, Japan.), Masato Uesugi (National Space Development Agency, Ibaraki, Japan.), Masato Nakajima (National Space Development Agency, Ibaraki, Japan.), Mitsuhiro Nakamura (National Space Development Agency, Ibaraki, Japan.), and Tooru Kanno (National Space Development Agency, Ibaraki, Japan.) *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 309-314 In JAPANESE Prepared in cooperation with Japan Atomic Energy Research Inst., Tokai (For primary document see N93-20410 07-12)
Avail: CASI HC A02/MF A03

N93-20484# National Space Development Agency, Tokyo (Japan). Parts and Material Management Office.
RESEARCH ON SINGLE EVENT RESISTANCE EVALUATION TECHNOLOGY: SINGLE EVENT RESISTANCE EVALUATION BY SEM [SHINGURU IBENTO TAISEI NO HYOUKA GIJUTSU NO KENKYUU: SEM NI YORU SHINGURU IBENTO TAISEI NO HYOUKA]
Satoshi Kuboyama and Jirou Aoki (National Space Development Agency, Ibaraki, Japan.) *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 315-320 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A02/MF A03

N93-20485# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.
RESEARCH ON SINGLE EVENT PHENOMENON ON SEMICONDUCTOR DEVICES Report No. 6 [HANDOUTAI DEBAISU NO SHINGURU IBENTO NI KANSURU KENKYUU]
Sumio Matsuda, Takashi Tamura, and Masato Uesugi *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 321-324 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20486# National Space Development Agency, Tokyo (Japan). Parts and Material Management Office.
CONSTRUCTION OF EVALUATION TEST EQUIPMENT FOR 16 BIT SPACE MPU [UCHUUYOU 16 BITTO MPU HYOUKA SHIKEN SOUCHI NO SEIBI]
Satoshi Kuboyama, Yasuhiro Aikawa, and Jirou Aoki *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 325-326 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N93-19965# Pennsylvania State Univ., University Park. Applied Research Lab.

DIGITAL IMAGE PROCESSING OF HYDROGEN BUBBLE LINES FOR INSTANTANEOUS VELOCITY PROFILES

S. D. Brurieau and W. R. Pauley Nov. 1992 114 p

(Contract N00014-90-J-1365)

(AD-A258592; PSU/ARL-TR-92-10) Avail: CASI HC A06/MF A02

Boundary layer transition and turbulence have been described as being comprised of smaller structures called turbulent spots. Many researchers have obtained ensemble averaged velocity measurements in the transition region and some attempts have been made to obtain instantaneous information. Ensemble averaging can predict the overall scales of the flow field but it fails to yield information on the flow physics of the substructures within the spot. To facilitate investigation of these flow features and to establish the spot's relationship with transition or turbulence, an experimental method to obtain instantaneous full velocity profiles has been developed. The qualitative hydrogen bubble technique of flow visualization has been augmented to yield quantitative unsteady boundary layer information. The technique has been advanced by incorporating digital image processing of videotaped boundary layer flow. The method was verified by direct comparison with a laser Doppler anemometer and an analytical uncertainty analysis was performed. The technique compared well against the LDA, in both steady and unsteady flows. Recommendations were made for effective use of this technique and for further development. GRA

N93-19969*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

THREE-DIMENSIONAL NAVIER-STOKES HEAT TRANSFER PREDICTIONS FOR TURBINE BLADE ROWS

Robert J. Boyle and Paul W. Giel (Sverdrup Technology, Inc., Brook Park, OH.) Jul. 1992 16 p Presented at the 28th Joint Propulsion Conference and Exhibit, Nashville, TN, 6-8 Jul. 1992; sponsored by the AIAA, SAE, ASME, and ASEE Previously announced in IAA as A92-54003

(RTOP 505-62-52)

(NASA-TM-105800; E-7230; NAS 1.15:105800; AIAA Paper 92-3068)

Avail: CASI HC A03/MF A01

Results are shown for a three-dimensional Navier-Stokes analysis of both the flow and the surface heat transfer for turbine applications. Heat transfer comparisons are made with the experimental shock-tunnel data of Dunn and Kim, and with the data of Blair for the rotor of the large scale rotating turbine. The analysis was done using the steady-state, three-dimensional, thin-layer Navier-Stokes code developed by Chima, which uses a multistage Runge-Kutta scheme with implicit residual smoothing. An algebraic mixing length turbulence model is used to calculate turbulent eddy viscosity. The variation in heat transfer due to variations in grid parameters is examined. The effects of rotation, tip clearance, and inlet boundary layer thickness variation on the predicted blade and endwall heat transfer are examined. Author

N93-19980*# Florida State Univ., Tallahassee. Dept. of Mathematics.

STABILITY OF MIXING LAYERS Annual Progress Report, 23 Jan. 1992 - 22 Jan. 1993

Christopher Tam and A Krothapalli 22 Jan. 1993 13 p

(Grant NAG1-1372)

(NASA-CR-192225; NAS 1.26:192225) Avail: CASI HC A03/MF A01

The research program for the first year of this project (see the original research proposal) consists of developing an explicit marching scheme for solving the parabolized stability equations (PSE). Performing mathematical analysis of the computational algorithm including numerical stability analysis and the determination of the proper boundary conditions needed at the boundary of the computation domain are implicit in the task. Before one can solve the parabolized stability equations for high-speed mixing layers, the mean flow must first be found. In the past, instability analysis of high-speed mixing layer has mostly been performed on mean flow profiles calculated by the boundary layer equations. In carrying out this project, it is believed that the boundary layer equations might not give an accurate enough nonparallel, nonlinear mean flow needed for parabolized stability analysis. A more accurate mean flow can, however, be found by solving the parabolized Navier-Stokes equations. The advantage of the parabolized Navier-Stokes equations is that its accuracy is consistent with the PSE method. Furthermore, the method of solution is similar. Hence, the major part of the effort of the work of this year has been devoted to the development of an explicit numerical marching scheme for the solution of the Parabolized Navier-Stokes equation as applied to the high-seed mixing layer problem. Derived from text

N93-19999# Scientific Research Associates, Inc., Glastonbury, CT.

PROJECTILE BASE BLEED TECHNOLOGY. PART 2: USER'S GUIDE CMINT COMPUTER CODE, VERSION 5.04-BRL Final Report, Jul. 1988 - Jul. 1991

Howard J. Gibeling and Richard C. Buggeln Nov. 1992 126 p

(Contract DAA15-88-C-0040)

(AD-A258630; R91-930020F; ARL-CR-3) Avail: CASI HC A07/MF A02

Detailed finite rate chemistry models for H2, and H2-CO combustion have been incorporated into a Navier-Stokes computer code and applied to flow field simulation in the base region of an M864 base burning projectile. Results without base injection were obtained using a low Reynolds number k-epsilon turbulence model and several mixing length turbulence models. The results with base injection utilized only the Baldwin-Lomax model for the Projectile forebody and the Chow wake mixing model downstream of the projectile base. A validation calculation was performed for a supersonic hydrogen-air burner using an H, reaction set which is a subset of the H2-CO reaction set developed for the base combustion modeling. The comparison with the-available experimental data was good, and provides a level of validation for the technique and code developed. Projectile base injection calculations were performed for a flat base M864 projectile at M(infinity) = 2. Hot air injection, H2 injection and H2-CO injection were modeled, and computed results show reasonable trends in the base pressure increase (base drag reduction), base corner expansion and downstream wake closure location. GRA

N93-20035*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

ASSESSMENT OF HIGHER ORDER TURBULENCE MODELS FOR COMPLEX TWO- AND THREE-DIMENSIONAL FLOWFIELDS

Florian R. Menter (Eloret Corp., Palo Alto, CA.) Sep. 1992 29 p

(RTOP 505-59-40)

(NASA-TM-103944; A-92124; NAS 1.15:103944) Avail: CASI HC A03/MF A01

A numerical method is presented to solve the three-dimensional Navier-Stokes equations in combination with a full Reynolds-stress turbulence model. Computations will be shown for three complex flowfields. The results of the Reynolds-stress model will be compared with those predicted by two different versions of the k-omega model. It will be shown that an improved version of the k-omega model gives as accurate results as the Reynolds-stress model. Author

N93-20049# Technical Univ. of Lisbon (Portugal).

INTERNATIONAL SYMPOSIUM ON APPLICATIONS OF LASER TECHNIQUES TO FLUID MECHANICS AND WORKSHOP ON COMPUTERS IN FLOW MEASUREMENTS NO. 6

23 Jul. 1992 800 p Workshop held in Lisbon, Portugal, 20-23 Jul. 1992

(Contract DAJA45-92-M-0288)

(AD-A258510; R/D-6853.AN-02) Avail: CASI HC A99/MF A10

Papers presented at the Sixth International Symposium on Applications of Laser Techniques to Fluid Mechanics and Workshop on Computers in Flow Measurements held in Lisbon, on 20-23 Jul. 1992 are included. The aim of the symposium is to provide a forum for the presentation of new research on laser techniques for flow measurements and results of significance to fluid mechanics. The application of laser techniques to scientific and engineering investigations of fluid flow is emphasized, but contributions to the theory and practice of laser methods are considered where they facilitate new improved fluid mechanic investigations. Attention is focused on laser-Doppler anemometry, particle sizing, and other methods

for the measurement of velocity and scalars, such as particle image velocimetry and laser induced fluorescence. GRA

N93-20057*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

NUMERICAL SIMULATION OF A HIGH MACH NUMBER JET FLOW

M. Ehtesham Hayder, Eli Turkel, and Reda R. Mankbadi Jan. 1993 17 p Presented at the 31st Aerospace Sciences Meeting and Exhibit, Reno, NV, 11-14 Jan. 1993; sponsored by AIAA

(RTOP 505-62-21)

(NASA-TM-105985; E-7509; NAS 1.15:105985; AIAA Paper 93-0653; ICOMP-92-26) Avail: CASI HC A03/MF A01

The recent efforts to develop accurate numerical schemes for transition and turbulent flows are motivated, among other factors, by the need for accurate prediction of flow noise. The success of developing high speed civil transport plane (HSCT) is contingent upon our understanding and suppression of the jet exhaust noise. The radiated sound can be directly obtained by solving the full (time-dependent) compressible Navier-Stokes equations. However, this requires computational storage that is beyond currently available machines. This difficulty can be overcome by limiting the solution domain to the near field where the jet is nonlinear and then use acoustic analogy (e.g., Lighthill) to relate the far-field noise to the near-field sources. The later requires obtaining the time-dependent flow field. The other difficulty in aeroacoustics computations is that at high Reynolds numbers the turbulent flow has a large range of scales. Direct numerical simulations (DNS) cannot obtain all the scales of motion at high Reynolds number of technological interest. However, it is believed that the large scale structure is more efficient than the small-scale structure in radiating noise. Thus, one can model the small scales and calculate the acoustically active scales. The large scale structure in the noise-producing initial region of the jet can be viewed as a wavelike nature, the net radiated sound is the net cancellation after integration over space. As such, aeroacoustics computations are highly sensitive to errors in computing the sound sources. It is therefore essential to use a high-order numerical scheme to predict the flow field. The present paper presents the first step in a ongoing effort to predict jet noise. The emphasis here is in accurate prediction of the unsteady flow field. We solve the full time-dependent Navier-Stokes equations by a high order finite difference method. Time accurate spatial simulations of both plane and axisymmetric jet are presented. Jet Mach numbers of 1.5 and 2.1 are considered. Reynolds number in the simulations was about a million. Our numerical model is based on the 2-4 scheme by Gottlieb & Turkel. Bayliss et al. applied the 2-4 scheme in boundary layer computations. This scheme was also used by Ragab and Sheen to study the nonlinear development of supersonic instability waves in a mixing layer. In this study, we present two dimensional direct simulation results for both plane and axisymmetric jets. These results are compared with linear theory predictions. These computations were made for near nozzle exit region and velocity in spanwise/azimuthal direction was assumed to be zero. Author

N93-20061# Ecole Centrale de Lyon (France). Lab. de Mecanique des Fluides et d'Acoustique.

STUDY OF A TURBULENT BOUNDARY LAYER MODIFIED BY THE INSERTION OF A LARGE EDDY BREAK UP (LEBU) DEVICE Ph.D. Thesis [ETUDE DE LA MODIFICATION D'UNE COUCHE LIMITE TURBULENTE PAR L'INSERTION D'UN MANIPULATEUR TYPE REDUCTEUR DE TRAINEE]

Eric Augier 1992 141 p In FRENCH

(ECL-92-11; ETN-93-93053) Avail: CASI HC A07/MF A02

Improving the understanding of the fundamental mechanisms acting in turbulent structures is discussed. An experimental study is performed and the data provided information on physical phenomena. A theoretical approach is carried out to complete the study. Based on the unsteady aerodynamic and rapid distortion theory, a model which takes into account the 'unwinding vortex' effect, is developed. This model is compared with data. The results show the efficiency of this theory. The comparison of the data with a k-epsilon model shows that the modification of a boundary layer by a thin plate is also a diffusion problem. The initial modeling is improved by including the intermittency effect. ESA

N93-20063*# Michigan Technological Univ., Houghton. Coll. of Engineering.

FILM CONDENSATION IN A HORIZONTAL RECTANGULAR DUCT

Qing Lu and N. V. Suryanarayana Cleveland, Ohio Jan. 1993 243 p (Grant NAG3-711; RTOP 506-41-51)

(NASA-CR-191061; E-7550; NAS 1.26:191061) Avail: CASI HC A11/MF A03

Condensation heat transfer in a horizontal rectangular duct was experimentally and analytically investigated. To prevent the dripping of condensate on the film, the experiment was conducted inside a horizontal rectangular duct with vapor condensing only on the bottom cooled plate of the duct. R-113 and FC-72 (Fluorinert Electronic Fluid developed by the 3M Company) were used as the condensing fluids. The experimental program included measurements of film thickness, local and average heat transfer coefficients, wave length, wave speed, and a study of wave initiation. The measured film thickness was used to obtain the local heat transfer coefficient. The wave initiation was studied both with condensation and with an adiabatic air-liquid flow. The test sections used in both experiments were identical. Author

N93-20168# George Washington Univ., Washington, DC. School of Engineering and Applied Science.

A FINITE-DIFFERENCE MULTIGRID ALGORITHM FOR THE DIRECT NUMERICAL SIMULATION OF TRANSITION AND TURBULENCE IN INCOMPRESSIBLE FLOW Ph. D. Thesis

Steven Eric Krist 14 Feb. 1993 245 p

Avail: CASI HC A11/MF A03

Some of the unresolved issues which arise when using finite-difference spatial discretizations in direct numerical simulation of transition and turbulence are examined in this investigation. The focus of attention is on the development and validation of a finite-difference code for conducting temporal simulations of transition to turbulence in incompressible plane Poiseuille flow; the Taylor-Green vortex problem is also considered. In order to place the present research in its proper context, an extensive review of experimental, theoretical, and numerical investigations of the channel transition problem is provided. Derived from text

N93-20243# Purdue Univ., West Lafayette, IN. School of Mechanical Engineering.

INJECTION OF DRAG-REDUCING ADDITIVES INTO TURBULENT WATER FLOWS. INVESTIGATION OF LASER-INDUCED FLUORESCENCE FOR CONCENTRATION MEASUREMENTS Final Report, 1 Dec. 1990 - 15 May 1992

Andreas C. Schwarz and William G. Tiederman Dec. 1992 67 p (Contract N00014-91-J-1446)

(AD-A259459; PME-FM-92-1) Avail: CASI HC A04/MF A01

The concentration measurements of injected fluid in a turbulent water flow require a non-intrusive, high speed technique in order to capture the high frequency concentration fluctuations without disturbing the flow. A Laser-Induced Fluorescence (LIF) technique was evaluated where special attention was directed towards the theoretical background and its application in the laboratory. Concentration measurements were performed during the injection of dyed water and a dyed, aqueous solution of a polyacrylamide into a fully-developed turbulent channel flow. A mass balance performed on a two-dimensional control volume using independent measurements of the streamwise velocity and the mean concentration yielded a significant deficit. Since it was unreasonable to attribute the imbalance to uncertainties in the measurements of the streamwise velocity, the main objective was to carefully evaluate the concentration measurement technique. After having investigated the performance of the injector slot with respect to uniform injection, different experimental parameters that have an impact on the concentration measurements were varied. In the case of water-injected flow, it could be shown that the instantaneous array voltages have to be kept within a certain range which has to be determined prior to the experiment and depends on the saturation of the photo-diodes which are charged-coupled devices. In the case of polymer-injected flow, the additional issues that influence the evaluation of the mass flux are nonuniform injection and a displacement of the probe volumes in the high concentration, near-wall region. GRA

N93-20244# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
NUMERICAL SOLUTION OF THREE-DIMENSIONAL UNSTEADY VISCOUS FLOWS Final Report, 1 Dec. 1988 - 30 Nov. 1992
Lakshmi N. Sankar and Wam-Gyu Park Dec. 1992 99 p
(Contract N00014-89-J-1319)
(AD-A259464) Avail: CASI HC A05/MF A02

The behavior of free shear layers within ramjet dump combustors is studied through the numerical solution of unsteady compressible Navier-Stokes equations. Three configurations are considered: (1) a short combustor with an open downstream boundary, (2) a long combustor with an open downstream boundary, and (3) a short combustor with a partially blocked downstream boundary. Vorticity contours of the computed flow fields in all the three cases reveal oscillations of the shear layer, roll up and shedding of organized vortices. A Fourier analysis of the computed flow fields indicates that the natural acoustic frequency of the system, and the natural shear layer instability frequency are the two dominant frequencies of the flow field. It is also observed that the boundary conditions play a crucial role in the behavior of the combustor flow field. GRA

N93-20253*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
STATISTICAL ANALYSIS OF THE RATE OF STRAIN TENSOR IN COMPRESSIBLE HOMOGENEOUS TURBULENCE
G. Erlebacher and S. Sarkar Apr. 1992 40 p
(Contract NAS1-18605; RTOP 505-90-52-01)
(NASA-CR-189640; NAS 1.26:189640; ICASE-92-18) Avail: CASI HC A03/MF A01

Recent analysis of direct numerical simulations of compressible homogeneous shear flow turbulence has unraveled some of the energy transfer mechanisms responsible for the decrease of kinetic energy production when the flow becomes more compressible. In this complementary study, we focus our attention on the rate of strain tensor. A Helmholtz decomposition of the velocity field leads us to consider a solenoidal and an irrotational rate of strain tensor. Their eigenvalue distributions, eigenvector orientations, and the relative alignment between the eigenvectors and the vorticity and pressure gradient vectors are examined with the use of probability density functions. The irrotational rate of strain tensor is found to have a preferred structure in regions of strong dilatation. This structure depends on the mean shear and is quite different from that of the solenoidal rate of strain tensor. Compressibility strongly affects the orientation properties of the pressure gradient vector. Author

N93-20254*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
ON THE STABILITY OF NONLINEAR VISCOUS VORTICES IN THREE-DIMENSIONAL BOUNDARY LAYERS
Andrew P. Bassom (Exeter Univ., England.) and S. R. Otto Apr. 1992 50 p
(Contract NAS1-18605; RTOP 505-90-52-01)
(NASA-CR-189637; NAS 1.26:189637; ICASE-92-15) Avail: CASI HC A03/MF A01

Recently it was demonstrated that three-dimensionality can play an important role in dictating the stability properties of any Goertler vortices which a particular boundary layer may support. According to a linearized theory, vortices within a high Goertler number flow can take one of two possible forms within a two-dimensional flow supplemented by a small crossflow of size O(R(sub e)(exp -1/2)G(exp 3/5)) where R(sub e) is the Reynolds number of the flow and G the Goertler number. It has been shown that these forms are characterized by O(1) wavenumber inviscid disturbances and larger, O(G(exp 1/5)), wavenumber modes which are trapped within a thin layer adjacent to the bounding surface. Here we concentrate on the latter, essentially viscous vortices and describe their weakly nonlinear stability properties in the presence of crossflow. It is shown conclusively that the effect of crossflow is to stabilize the nonlinear disturbances and the calculations herein allow stable, finite amplitude perturbations to be found. Predictions are made concerning the likelihood of observing some of these viscous modes within a practical setting and asymptotic work permits discussion of the stability properties of modes with wavenumbers which are small relative to the implied O(G(exp 1/5)) scaling. Author

N93-20268*# Toledo Univ., OH. Dept. of Mechanical Engineering.
ANALYSIS AND EVALUATION OF AN INTEGRATED LAMINAR FLOW CONTROL PROPULSION SYSTEM Final Technical Report
Theo G. Keith, Jr. and Kenneth J. Dewitt Feb. 1993 53 p
(Grant NAG3-937)
(NASA-CR-192162; NAS 1.26:192162) Avail: CASI HC A04/MF A01

Reduction of drag has been a major goal of the aircraft industry as no other single quantity influences the operating costs of transport aircraft more than aerodynamic drag. It has been estimated that even modest reduction of frictional drag could reduce fuel costs by anywhere from 2 to 5 percent. Current research on boundary layer drag reduction deals with various approaches to reduce turbulent skin friction drag as a means of improving aircraft performance. One of the techniques belonging to this category is laminar flow control in which extensive regions of laminar flow are maintained over aircraft surfaces by delaying transition to turbulence through the ingestion of boundary layer air. While problems of laminar flow control have been studied in some detail, the prospect of improving the propulsion system of an aircraft by the use of ingested boundary layer air has received very little attention. An initial study for the purpose of reducing propulsion system requirements by utilizing the kinetic energy of boundary layer air was performed in the mid-1970's at LeRC. This study which was based on ingesting the boundary layer air at a single location, did not yield any significant overall propulsion benefits; therefore, the concept was not pursued further. However, since then it has been proposed that if the boundary layer air were ingested at various locations on the aircraft surface instead of just at one site, an improvement in the propulsion system might be realized. The present report provides a review of laminar flow control by suction and focuses on the problems of reducing skin friction drag by maintaining extensive regions of laminar flow over the aircraft surfaces. In addition, it includes an evaluation of an aircraft propulsion system that is augmented by ingested boundary layer air. Derived from text

N93-20270# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
A STUDY OF HEAT FLUX INDUCED DRYOUT IN CAPILLARY GROOVES M.S. Thesis
Timothy J. Murphy Dec. 1992 245 p
(AD-A259175; AFIT/GA/ENY/92D-06) Avail: CASI HC A11/MF A03

This is an experimental study of ethanol flowing in the narrow grooves of a copper plate which is subjected to heat fluxes sufficient to evaporate more liquid than can be replaced by capillary pumping. Three groove geometries are used: square, rectangle, and trapezoid. The objective is to simulate aspects of liquid flow in heat pipes with axial grooves. In order to validate analytical models of capillary flow in grooves, the capillary limit, dryout front location, and dryout front movement in response to power draw downs are documented. The results show the rewet performance of the groove is dependent on geometry. Grooves of higher heat transfer capacity can be poor for recovering from dryout, like the trapezoidal groove. Comparisons of the theoretical maximum heat transfer with the data are good for the square and rectangle, but overestimate the value for the trapezoid. No theory sufficiently predicted the location of the dryout front for the three geometries. For both a quiescent dryout front and a boiling dryout front, the theory does not utilize an accurate description of the geometry of the liquid front which is critical for determining the capillary pressure difference. GRA

N93-20289 North Carolina State Univ., Raleigh.
MEAN FLOW INTERACTIONS OF A COUNTER-ROTATING PROPELLER Ph.D. Thesis
Jin-Deog Chung 1992 163 p
Avail: Univ. Microfilms Order No. DA9300007

The aerodynamic interaction between the forward and rear rotors in a counter rotating (CRP) system, has been examined using a double conditional sampling methodology applied to 3-D thermal anemometer data. The technique effectively freeze the rotors in any desired relative position and provides the inter-rotor flow field. Axial, radial and circumferential steady mean flow between rotors is shown relative to the 'fixed' forward rotor for various 'fixed' rear rotor positions. The effects of the upstream disturbance from the rear rotor on the wakes of the forward rotor blades have been documented. This disturbance occurs in all three flow components and varies with distance from the rear rotor and with radial location. Modulations of the forward wakes depend upon the relative rear rotor locations. As the rear rotor continues to rotate past the forward blade, the location of the

peak velocity from the forward blades moves circumferentially and springs back as the cycle repeats for the next rear blade. This is a 'wiggling' motion. Double conditional sampling is also used to evaluate the determining CRP flow field by superposing the flow that would occur as a result of the forward and rear rotors operating separately. Simulation of conditions on both rotors that occur in the CRP configuration is attempted by duplicating alternately RPM's, inflow conditions, angles of attack and power and thrust coefficients. The superposition for the various single rotor operating conditions does not yield an acceptable accuracy of wave forms and magnitude simultaneously. The velocity vectors of the cross-stream component show that superposition does not produce the identical flow direction and magnitude of the actual flow. Dissert. Abstr.

N93-20290 Maryland Univ., College Park.
VISUALIZATION OF TURBULENT FLOWS WITH SIMULTANEOUS VELOCITY AND VORTICITY MEASUREMENTS Ph.D. Thesis
Lawrence Ong 1992 209 p
Avail: Univ. Microfilms Order No. DA9234633

An experimental study of the turbulent boundary layer at Re(sub theta) approx. equals 1070 was conducted. This study combines velocity and vorticity measurements using a nine-sensor hot-wire probe with simultaneously obtained flow visualization images. Detailed measurements within the boundary layer with and without smoke marking of the wall layer fluid were performed at various distances from the wall, ranging from approximately y(+) approx. equals 14 to y(+) approx. equals 156, and at three axial locations downstream from the smoke injection slot. The mean statistical properties of the fluctuating velocity and vorticity components agree well with previous experimental and numerically simulated data. These boundary layer measurements were used in a joint probability analysis of the various instantaneous velocity, velocity gradient and vorticity correlations that appear in the vorticity and enstrophy transport equations. Substantial evidence supporting postulated inclined vortex models was found. Conditional analysis based on the detection of strong Reynolds stress and enstrophy events was carried out. The combined visual and hot-wire data provide evidence showing that these smoke marked regions in the flow field, which indicate vertical mass flux, are also regions of high vertical momentum flux. Dissert. Abstr.

N93-20297*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.
METHODOLOGY FOR SENSITIVITY ANALYSIS, APPROXIMATE ANALYSIS, AND DESIGN OPTIMIZATION IN CFD FOR MULTIDISCIPLINARY APPLICATIONS Progress Report, 15 Apr. 1992 - 31 Jan. 1993
Arthur C. Taylor, III and Gene W. Hou Feb. 1993 36 p
(Grant NAG1-1265)
(NASA-CR-192172; NAS 1.26:192172) Avail: CASI HC A03/MF A01

In this study involving advanced fluid flow codes, an incremental iterative formulation (also known as the delta or correction form) together with the well-known spatially-split approximate factorization algorithm, is presented for solving the very large sparse systems of linear equations which are associated with aerodynamic sensitivity analysis. For smaller 2D problems, a direct method can be applied to solve these linear equations in either the standard or the incremental form, in which case the two are equivalent. Iterative methods are needed for larger 2D and future 3D applications, however, because direct methods require much more computer memory than is currently available. Iterative methods for solving these equations in the standard form are generally unsatisfactory due to an ill-conditioning of the coefficient matrix; this problem can be overcome when these equations are cast in the incremental form. These and other benefits are discussed. The methodology is successfully implemented and tested in 2D using an upwind, cell-centered, finite volume formulation applied to the thin-layer Navier-Stokes equations. Results are presented for two sample airfoil problems: (1) subsonic low Reynolds number laminar flow; and (2) transonic high Reynolds number turbulent flow. Author

N93-20299*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
COMPUTATIONAL PARAMETRIC STUDY OF SIDEWALL-COMPRESSION SCRAMJET INLET PERFORMANCE AT MACH 10
Scott D. Holland Washington Feb. 1993 14 p
(RTOP 506-40-71-04)
(NASA-TM-4411; L-17134; NAS 1.15:4411) Avail: CASI HC A03/MF A01

A computational parametric study of three-dimensional, sidewall-compression scramjet inlets was performed to identify the effects of geometric parameters on inlet performance. The parameters were the leading-edge sweep angle, varied between 30 and 60 deg, and the leading-edge position of the cowl, located at the throat and at two forward positions. A laminar boundary layer with cold-wall (T(sub wall) = 300 K (540 R)) boundary conditions was imposed. The parametric study was performed for a Mach number of 10 and a unit free-stream Reynolds number of 7.06 x 10(exp 6) per meter (2.15 x 10(exp 6) per foot) at a geometric contraction ratio of 5. The performance of each configuration was evaluated in terms of the mass capture, throat Mach number, total pressure recovery, kinetic energy efficiency, and internal compression. One computation of an unswept configuration was included as a baseline to determine the effects of introducing leading-edge sweep on the flow-field parameters. The purpose of the computational parametric study was to perform a trade-off of the effects of various parameters on the global performance of the inlet. Although no single optimal configuration emerged, trade-offs among the stated performance parameters identified a leading-edge sweep angle of 45 deg as possessing the most attractive performance characteristics. Author

N93-20321# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
SOLUTION OF A ONE-DIMENSIONAL ABLATION MODEL [SOLUCAO DE UM MODELO DE ABLACAO UNIDIMENSIONAL]
Nerbe Jose RupertiJunior Nov. 1991 103 p In PORTUGESE
(INPE-5357-TDI/464) Avail: CASI HC A06/MF A02

Ablation in multilayered one-dimensional media is studied. A finite element technique using a Streamline Upwind/Petrov-Galerkin (SU/PG) formulation is employed with a moving mesh which adapts itself to the moving boundary at each time step. The SU/PG formulation is used to avoid oscillations caused by first order derivatives in the energy equation. Ablation problems with time-dependent heat fluxes and a typical example in aerospace thermal protection applications are solved. Critical comparisons are made with finite differences results recently obtained through the control volume approach with exponential differencing. The generalized integral transform technique (GITT) is used as an alternative solution to ablation in multilayered media and to validate the results obtained by the finite element method. The eigenvalues needed in the GITT solution are determined simultaneously with the tansformed temperatures by rewriting the associated transcedental equations into ordinary differential equations. Author

N93-20408# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
A COMPARISON OF COMPUTATIONAL FLUID DYNAMICS COMPUTER PROGRAMS FOR HYPERSONIC PROPULSIVE NOZZLE FLOWFIELDS M.S. Thesis
Kennedy B. Wilson, Jr. Dec. 1992 127 p
(AD-A259146; AFIT/GAE/ENY/92D-27) Avail: CASI HC A07/MF A02

This study compared the results of two computer programs, a flux-difference-splitting (FDS) Godunov-based scheme and the SCRAMjet Hypersonic Nozzle (SCHNOZ) parabolized Navier-Stoke's code using MacCormack's method, applied to a hypersonic nozzle flowfield. Two different nozzle geometries were investigated at three Mach numbers along a typical hypersonic flight trajectory. A direct comparison between the SCHNOZ and FDS programs was made by numerically solving the steady Euler equations using a frozen flow assumption in the nozzle. The frozen flow SCHNOZ code is currently 6 to 10 times more efficient in terms of computational time than the FDS frozen flow code. The SCHNOZ and FDS codes demonstrated comparable accuracy in modeling the flow physics. The implementation of the viscous terms in the SCHNOZ code proved to be ineffectual in modeling the viscous effects in the flowfield. The finite rate chemistry effects were important for the nozzle inlet conditions considered. GRA

N93-20599# Chemical Research and Development Center, Aberdeen Proving Ground, MD.
APPLICATION OF SILICONE FLUID RHEOGONIOMETER MEASUREMENTS TO DESPIN MOMENT STUDIES IN A SPINNING AND CONING CYLINDER Final Report, Jun. - Nov. 1989
Raymond P. Tytus Sep. 1992 34 p
(AD-A259270; CRDEC-TR-414) Avail: CASI HC A03/MF A01

A Weissenberg rheogoniometer was used to measure the viscosity and normal stress for a series of high viscosity silicone fluids that were used in despin moment studies of a spinning and coning cylinder. The measurements indicated viscosity shear thinning and significant normal stress at high shear rates. The effect of this non-Newtonian fluid behavior on despin moment was then investigated. Two simple viscoelastic fluid constitutive models, a differential and second order fluid, were evaluated using the fluid rheology data. The differential model fit the fluid rheology data better than the second order fluid, which does not predict shear thinning. Derived differential model parameters were used to calculate theoretical despin moments for the silicone fluids in an infinitely long cylinder. The despin moments for the higher viscosity fluids were found to be significantly higher than those predicted for Newtonian fluids; however, they compared qualitatively with despin moment test results, which were also significantly higher. From this analysis, it appears that the differences between the despin moment test results for the higher viscosity silicone fluids and theoretical predictions for Newtonian fluids can be attributed to the viscoelastic properties of the silicone fluids. GRA

N93-20748*# Brown Univ., Providence, RI. Div. of Applied Matematics.
RESEARCH IN COMPUTATIONAL FLUID DYNAMICS AND ANALYSIS OF ALGORITHMS Semiannual Report, Oct. 1991 - Oct. 1992
David Gottlieb Oct. 1992 24 p
(Grant NAG1-703)
(NASA-CR-192309; NAS 1.26:192309) Avail: CASI HC A03/MF A01

Recently, higher-order compact schemes have seen increasing use in the DNS (Direct Numerical Simulations) of the Navier-Stokes equations. Although they do not have the spatial resolution of spectral methods, they offer significant increases in accuracy over conventional second order methods. They can be used on any smooth grid, and do not have an overly restrictive CFL dependence as compared with the O(N(exp -2)) CFL dependence observed in Chebyshev spectral methods on finite domains. In addition, they are generally more robust and less costly than spectral methods. The issue of the relative cost of higher-order schemes (accuracy weighted against physical and numerical cost) is a far more complex issue, depending ultimately on what features of the solution are sought and how accurately they must be resolved. In any event, the further development of the underlying stability theory of these schemes is important. The approach of devising suitable boundary clusters and then testing them with various stability techniques (such as finding the norm) is entirely the wrong approach when dealing with high-order methods. Very seldom are high-order boundary closures stable, making them difficult to isolate. An alternative approach is to begin with a norm which satisfies all the stability criteria for the hyperbolic system, and look for the boundary closure forms which will match the norm exactly. This method was used recently by Strand to isolate stable boundary closure schemes for the explicit central fourth- and sixth-order schemes. The norm used was an energy norm mimicking the norm for the differential equations. Further research should be devoted to BC for high order schemes in order to make sure that the results obtained are reliable. The compact fourth order and sixth order finite difference scheme had been incorporated into a code to simulate flow past circular cylinders. This code will serve as a verification of the full spectral codes. A detailed stability analysis by Carpenter (from the fluid Mechanics Division) and Gottlieb gave analytic conditions for stability as well as asymptotic stability. This had been incorporated in the code in form of stable boundary conditions. Effects of the cylinder rotations had been studied. The results differ from the known theoretical results. We are in the middle of analyzing the results. A detailed analysis of the effects of the heating of the cylinder on the shedding frequency had been studied using the above schemes. It has been found that the shedding frequency decreases when the wire was heated. Experimental work is being carried out to affirm this result.
Derived from text

N93-20752# Technische Univ., Delft (Netherlands). Faculty of Mathematics and Informatics.
SOME 2D TEST EXAMPLES FOR THE ISNaS INCOMPRESSIBLE CODE
Guus Segal and Kees Kassels 1991 39 p
(Rept-91-44; ETN-93-92013) Copyright Avail: CASI HC A03/MF A01

A 'classical' contravariant approach, using staggered grids, for use in the choice of the correct space discretization for the ISNaS incompressible code, is evaluated. The numerical results were extremely good even for very discontinuous grids. Because of this observation, it was decided to develop the three dimensional ISNaS incompressible code based on this approach, and to study other aproaches outside the ISNaS framework. The influence of the geometric conditions is considered. Pressure discretization is addressed. Remarks on the boundary conditions are made. Tests on the ISNaS code reliability are described. ESA

N93-20753*# MCAT Inst., San Jose, CA.
COMPUTATION OF INCOMPRESSIBLE VISCOUS FLOWS THROUGH TURBOPUMP COMPONENTS
Cetin Kiris and Leon Chang Feb. 1993 18 p Original contains color illustrations
(Contract NCC2-500)
(NASA-CR-192296; NAS 1.26:192296; MCAT-93-06) Avail: CASI HC A03/MF A01; 2 functional color pages

Flow through pump components, such as an inducer and an impeller, is efficiently simulated by solving the incompressible Navier-Stokes equations. The solution method is based on the pseudocompressibility approach and uses an implicit-upwind differencing scheme together with the Gauss-Seidel line relaxation method. the equations are solved in steadily rotating reference frames and the centrifugal force and the Coriolis force are added to the equation of motion. Current computations use a one-equation Baldwin-Barth turbulence model which is derived from a simplified form of the standard k-epsilon model equations. The resulting computer code is applied to the flow analysis inside a generic rocket engine pump inducer, a fuel pump impeller, and SSME high pressure fuel turbopump impeller. Numerical results of inducer flow are compared with experimental measurements. In the fuel pump impeller, the effect of downstream boundary conditions is investigated. Flow analyses at 80 percent, 100 percent, and 120 percent of design conditions are presented. Author

N93-20767*# MCAT Inst., San Jose, CA.
NUMERICAL COMPUTATION OF COMPLEX MULTI-BODY NAVIER-STOKES FLOWS WITH APPLICATIONS FOR THE INTEGRATED SPACE SHUTTLE LAUNCH VEHICLE
William M. Chan Feb. 1993 40 p Original contains color illustrations
(Contract NCC2-654)
(NASA-CR-192297; NAS 1.26:192297; MCAT-93-05) Avail: CASI HC A03/MF A01; 4 functional color pages

An enhanced grid system for the Space Shuttle Orbiter was built by integrating CAD definitions from several sources and then generating the surface and volume grids. The new grid system contains geometric components not modeled previously plus significant enhancements on geometry that has been modeled in the old grid system. The new orbiter grids were then integrated with new grids for the rest of the launch vehicle. Enhancements were made to the hyperbolic grid generator HYPGEN and new tools for grid projection, manipulation, and modification, Cartesian box grid and far field grid generation and post-processing of flow solver data were developed. Author

N93-20858# National Defence Research Establishment, Umea (Sweden).
RESEARCH ON CONTINUOUS AND INSTANTANEOUS HEAVY GAS CLOUDS: SUMMARY OF A JOINT EUROPEAN PROJECT [FORSKNING OM KONTINUERLIGA OCH MOMENTANA TUNGA GASMOLA: SAMMANFATTNING AV ETT EUROPEISKI SAMARBETSPROJEKT]
Stellan Winter Jun. 1992 91 p In SWEDISH
(FOA-C-40296-4.5; ETN-93-92601) Avail: CASI HC A05/MF A01; National Defence Research Establishment, S-901 82 Umea, Sweden, HC

A survey of the project BA, which was part of the Commission for the European Community research program 'major technological hazards' 1987-1990, is presented. In this project, the influence of variability and obstacles on heavy gases was studied by the help of field experiments, wind tunnel modeling and mathematical modeling. ESA

N93-20892# Technische Univ., Berlin (Germany). Fachbereich Physik.
THE STRUCTURES AND THE SENSITIVITY OF AN INCOMPRESSIBLE TURBULENT BOUNDARY LAYER IN THE VICINITY OF THE SEPARATION Ph.D. Thesis [UEBER DIE STRUKTUR UND DIE SENSIBILITAET EINER INKOMPRESSIBLEN TURBULENTEN GRENZSCHICHT AM RANDE DER ABLOESUNG]
Peter Dengel 1992 216 p In GERMAN
(ETN-93-92557) Avail: CASI HC A10/MF A03

Three stable boundary layer developments which are distinguished from one another only by small distinctive pressure gradients are presented. The flow structure of boundary layer is examined. It is shown that the profiles of the mean velocity after their transformation in the vicinity of the separation region for y/delta less than 0.05 present a universal form, the so called asymptotic profile, which includes the separation profile. An answer is given to the question of the sensitivity of such boundary layers with regard to small changes in the pressure distribution. The measured flow magnitudes of the three cases show differences up to plus or minus 50. The sensitivity of the used turbulence model on small changes in the pressure distribution can be verified. ESA

N93-20893# Ecole Centrale de Lyon (France). Lab. de Mecanique des Fluides et d'Acoustique.
USE OF THE BOUNDARY ELEMENT METHOD IN THE RESOLUTION OF THE QUASI-ELLIPTIC NAVIER-STOKES EQUATIONS: APPLICATION TO THE CALCULATION OF A TURBINE FLOW Ph.D. Thesis [UTILISATION DE LA METHODE DES ELEMENTS FRONTIERES DANS LA RESOLUTION DES EQUATIONS DE NAVIER-STOKES QUASI-ELLIPTIQUES: APPLICATION AU CALCUL D'UNE TURBINE]
Etienne Parkinson 1991 266 p In FRENCH
(ECL-91-13; ETN-93-91952) Avail: CASI HC A12/MF A03

The characteristics of a quasi elliptical Navier-Stokes code are presented. The theory and behavior of the boundary element method are detailed. The integral method is described. Its use is illustrated for analytical test cases and the integration with the quasi elliptical Navier-Stokes code is described. The calculation of the internal flow in a rectilinear turbine interblade channel is presented. ESA

N93-21023# Max-Planck-Inst. fuer Stroemungsforschung, Goettingen (Germany).
THE ACQUISITION OF VELOCITY FIELDS VIA THE AUTOMATIC ANALYSIS OF MOTION, EXEMPLARILY DEMONSTRATED IN A ROTATING FLUID [DIE ERFASSUNG VON GESCHWINDIGKEITSFELDERN DURCH AUTOMATISCHE BEWEGUNGSANALYSE AM BEISPIEL EINER ROTIERENDEN FLUESSIGKEIT]
Robert Paul 1991 80 p In GERMAN
(MPIS-102/1991; ETN-93-92590) Avail: CASI HC A05/MF A01

A new variation of particle image velocimetry is developed in order to measure velocity fields in a rotating flow. Velocity vectors are obtained from the relative positions of particle images. The method presented allows the sign of vectors to be obtained. The magnitude and direction of vectors is determined using a cross correlation analysis. Separate mapping is possible using a charge coupled device camera, by digitizing and storing the signals. Resolution can be improved by interpolating intermediate values. The velocity field is obtained in the axial radial and the radial azimuthal plane of the flow in a rotating container. Tne radial dependence of the azimuthal flow is ascertained. Some turbulent structures occurring in the radial axial plane are categorized and discussed. ESA

N93-21198*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ON THE STRUCTURE OF GASEOUS CONFINED LAMINAR DIFFUSION FLAMES: NUMERICAL INVESTIGATION
M. A. Mawid, D. L. Bulzan, and S. K. Aggarwal (Illinois Univ., Chicago.) Feb. 1993 25 p
(RTOP 505-62-21)
(NASA-TM-106039; E-7613; NAS 1.15:106039; ICOMP-93-3) Avail: CASI HC A03/MF A01

The structure and characteristics of gaseous confined laminar diffusion flames are investigated by numerically solving the time-dependent two-dimensional axisymmetric conservation equations. The numerical model accounts for the important chemical and physical processes involved, including axial diffusion, viscous effects, radial convection, and finite-rate chemistry. The numerical results clearly show that the flame has a finite thickness and leakage of fuel vapor into the flame zone is possible. The effect of heat release is found to induce some radial flow. Predicted flame shape and dimensions are compared to the classical Burke-Schumann flame. The numerically calculated flame is observed to be about 15 percent taller and 5 percent narrower than that of the Burke-Schumann solution under the same conditions. Author

N93-21219# Louisiana State Univ., Baton Rouge. Dept. of Mechanical Engineering.
ENHANCED HEAT TRANSFER IN RIBBED DUCTS USING VORTEX GENERATORS Annual Report, Jul. 1991 - Jun. 1992
Tod A. Myrum and Sumanta Acharya 10 Aug. 1992 48 p Sponsored by Gas Research Institute
(Contract GRI-5090-260-1961)
(PB93-114320; GRI-92/0333) Avail: CASI HC A03/MF A01

Local and average Nusselt number and overall pressure drop results were obtained experimentally for air flow (Re = 3450) in a ribbed duct with vortex generators (circular rods) placed immediately above or just downstream of select rib elements. In virtually all cases, the presence of the generators led to increases in the average Nusselt number, Nu, and decreases in the entropy generation per unit duct length, S'. The largest generator-induced enhancement occurred for the largest dimensionless rib pitch (PP/h = 38.4), where placing the largest diameter generators (d/h = 1.0) over every rib produced a 21 percent increase in Nu, and a 27 percent decrease in S'. For P/h - 19.2, the best performance corresponds to a 12 percent increase in Nu and a 9 percent decrease in S'. The local results demonstrated that the greatest generator-induced effect occurred behind the first generator, located at the entrance to the test section. Downstream, the generators typically had a minor impact on the local Nusselt number and frequently reduced the local Nusselt number. GRA

N93-21258# Rensselaer Polytechnic Inst., Troy, NY. Center for Multiphase Research.
A NUMERICAL SIMULATION OF TWO-PHASE JET SPREADING USING AN EULER-LAGRANGIAN TECHNIQUE
F. Bonetto, D. Drew, and R. T. Lahey, Jr. 1992 33 p
(Contract N00014-91-J-1271)
(AD-A259326) Avail: CASI HC A03/MF A01

The objective of this paper is to study the spreading of a submerged two phase jet. A plunging liquid jet impacting on a still liquid pool may carry under bubbles by entraining the surrounding gas. For low liquid jet turbulence, the measured average bubble size was about 200 m. For low void fraction, one may assume that the liquid velocity field is not disturbed by the presence of the bubbles. This allows the use of known solutions for the velocity field in a planar liquid jet. That is, the liquid flow may be solved by using Eulerian coordinates and neglecting the effect of the bubbles. The momentum equation for the bubbles was written in Lagrangian coordinates. The resulting equations are solved for bubble trajectories in the known liquid velocity field. GRA

N93-21264# Dalhousie Univ., Halifax (Nova Scotia). Dept. of Oceanography.
EFFECT OF SURFACE ACTIVE MATERIALS ON BUBBLE DYNAMICS IN TWO-PHASE FLOW Annual Report, 2 Dec. 1991 - 2 Dec. 1992
Bruce D. Johnson 23 Dec. 1992 5 p
(Contract N00014-91-J-1780)
(AD-A259340) Avail: CASI HC A01/MF A01

Our goal in this research is to relate bubble performance in processes such as bubble breaking, dissolution, coalescence, and breakup to bubble interfacial characteristics, including surface tension, surface charge, and surface rheological properties. This fiscal year we have studied bubble dissolution rates in clean fresh water and in sea water samples representing a wide range of biological activities. Previous measurements of bubble dissolution have used water that was equilibrated with a known atmosphere a process that takes many hours and results in alteration of chemical and biological properties. We have used a novel gas tension method to determine O2 and N2 partial pressures in the water phase. Our results indicate that mass transfer rates for dissolution in fresh water coincide with theoretical predictions, but those for sea water are always significantly less and especially at low Reynolds Numbers. Bubble coalescence and breaking of

bubbles at the air-water interface were observed in fresh water and sea water samples. Both process were observed to produce satellite bubbles. For example, millimeter-size bubbles breaking at the air-water interface each produced 20 or more bubbles of greater than 30 microns in diameter. GRA

N93-21296# Universitaet der Bundeswehr Muenchen, Neubiberg (Germany). Inst. fuer Raumfahrttechnik.

AXIAL RESPONSE AND PULSE BEHAVIOR OF A CYLINDRICAL LIQUID COLUMN. PART 2

Helmut F. Bauer 1991 49 p

(LRT-WE-9-FB-2-1991-Pt-2; ETN-93-93398) Avail: CASI HC A03/MF A01

The response of an axially excited cylindrical liquid column consisting of incompressible and frictionless liquid was investigated for various pulse excitations. The free liquid surface displacement and the velocity response were determined analytically for periodic rectangular and triangular excitation, as well as for pulses of duration and of rectangular, triangular, and sine wave pulses. The results shall be used for the experiment 'LICORE' (liquid column resonances) on the second German Spacelab mission D-2. ESA

N93-21297# Universitaet der Bundeswehr Muenchen, Neubiberg (Germany). Inst. fuer Raumfahrttechnik.

NATURAL AXISYMMETRIC FREQUENCIES OF CYLINDRICAL LIQUID COLUMN WITH ANCHORED FREE SURFACE

Helmut F. Bauer 1991 20 p

(LRT-WE-9-FB-3-1991; ETN-93-93399) Avail: CASI HC A03/MF A01

The natural axisymmetric frequencies of a cylindrical liquid column and an annular liquid layer between two discs and anchored liquid edges (stuck edges) were determined in a zero gravity environment. It was found that with increasing aspect ratio of the liquid system the natural frequencies decrease and that they are larger than those of liquid columns between two parallel plates with free (slipping) liquid edges. ESA

N93-21298# Universitaet der Bundeswehr Muenchen, Neubiberg (Germany). Inst. fuer Raumfahrttechnik.

NATURAL FREQUENCIES AND RESPONSE OF SPINNING LIQUID COLUMN WITH PARTIALLY SLIDING CONTACT LINE

Hemult F. Bauer 1991 18 p

(LRT-WE-9-FB-24-1991; ETN-93-93402) Avail: CASI HC A03/MF A01

The contact line of a liquid with a solid may, depending on the smoothness of the solid, the viscosity, the surface tension, and the excitation force, partially flow along the solid during oscillations. The influence of this effect upon the natural frequencies, the stability, and the response of the system was investigated at an oscillating and spinning cylindrical liquid column. ESA

N93-21382# Queensland Univ., Brisbane (Australia). Dept. of Civil Engineering.

EXPERIMENTS ON SMOOTH CANTILEVERED CIRCULAR CYLINDERS IN A LOW-TURBULENCE UNIFORM FLOW. PART 2: FLUCTUATING LOADS ON A CANTILEVER OF ASPECT RATIO 30

T. A. Fox and G. S. West Nov. 1991 49 p

(PB93-110500; RR-CE131; ISBN-0-86776-464-3) Avail: CASI HC A03/MF A01

Part 2 of this report presents details of an investigation into the fluctuating loads induced on a smooth, cantilevered circular cylinder with an aspect ratio of 30 immersed in a low-turbulence uniform flow. Experiments were carried out in a wind tunnel at Reynolds numbers of 4.4 x 10(exp 4) and 6.6 x 10(exp 4) and involved the measurement of fluctuating pressures and forces. Oil-flow visualization was performed to determine the flow pattern at the surface of the cylinder. The results reveal the nature of the disturbance induced by the flow around the free-end of a cantilever and the full extent of the spanwise variation of fluctuating pressures and forces. GRA

N93-21383# Queensland Univ., Brisbane (Australia). Dept. of Civil Engineering.

EXPERIMENTS ON SMOOTH CANTILEVERED CIRCULAR CYLINDERS IN LOW-TURBULENCE UNIFORM FLOW. PART 1: MEAN LOADING WITH ASPECT RATIOS IN THE RANGE 4 TO 30

T. A. Fox and G. S. West Nov. 1991 85 p

(PB93-111763; RR-CE130; ISBN-0-86776-461-9) Avail: CASI HC A05/MF A01

Part 1 of the report presents details of an investigation into the mean loading of smooth, cantilevered circular cylinders immersed in a low-turbulence uniform flow. Experiments were performed in a wind tunnel at a Reynolds number of 4.4 x 10(exp 4) for aspect ratios in the range 4 to 30. Mean surface pressures and vortex shedding frequencies were measured, from which the local mean pressure drag and Strouhal number were calculated at various spanwise locations. The results reveal the extent of the disturbance induced by the flow around the free-end of a cantilever and the existence of a significant aspect ratio of 13. GRA

N93-21454# Maryland Univ., College Park. Dept. of Mechanical Engineering.

ELECTROSTATIC ENHANCEMENT OF HEAT TRANSFER IN A GAS-TO-GAS HEAT EXCHANGER Final Report, Jul. 1991 - Jun. 1992

M. M. Ohadi and A. I. Ansari Jul. 1992 49 p

(Contract GRI-5091-260-2185)

(PB93-114338; GRI-92/0325) Avail: CASI HC A03/MF A01

This is the final report on the last phase of a four-year GRI-sponsored experimental effort on heat transfer enhancement in gas-to-gas heat exchangers utilizing the electrostatic (or electrohydrodynamic, EHD) technique. The feasibility of the technique and the role of various controlling parameters for basic pipe flows and in a double-pipe heat exchanger were addressed in the first three phases of the project. In the current, and last, phase the feasibility of the electrostatic technique as a compound heat transfer augmentation methodology and its use in multi-tube heat exchangers was investigated. The compound enhancement experiments were performed on a commercially available finned tube by performing experiments on a micro-finned tube in the presence of electric field. Next, to address some of the practical problems that may be associated with the EHD technique, a multi-tube shell-and-tube heat exchanger was designed, fabricated, and experimentally tested. It is demonstrated that the EHD effect when used in conjunction with a low-fin or enhanced tube can yield additional enhancements to the already enhanced configuration as much as 80 percent in the present experiments technique. GRA

N93-21662*# State Univ. of New York, Buffalo. Turbulence Research Lab.

LARGE EDDY SIMULATIONS AND DIRECT NUMERICAL SIMULATIONS OF HIGH SPEED TURBULENT REACTING FLOWS Semiannual Report, 1 Aug. 1992 - 31 Jan. 1993

P. Givi, S. H. Frankel, V. Adumitroaie, G. Sabini, and C. K. Madnia 31 Jan. 1993 121 p

(Grant NAG1-1122)

(NASA-CR-192654; NAS 1.26:192654) Avail: CASI HC A06/MF A02

The primary objective of this research is to extend current capabilities of Large Eddy Simulations (LES) and Direct Numerical Simulations (DNS) for the computational analyses of high speed reacting flows. Our efforts in the first two years of this research have been concentrated on a priori investigations of single-point Probability Density Function (PDF) methods for providing subgrid closures in reacting turbulent flows. In the efforts initiated in the third year, our primary focus has been on performing actual LES by means of PDF methods. The approach is based on assumed PDF methods and we have performed extensive analysis of turbulent reacting flows by means of LES. This includes simulations of both three-dimensional (3D) isotropic compressible flows and two-dimensional reacting planar mixing layers. In addition to these LES analyses, some work is in progress to assess the extent of validity of our assumed PDF methods. This assessment is done by making detailed companions with recent laboratory data in predicting the rate of reactant conversion in parallel reacting shear flows. This report provides a summary of our achievements for the first six months of the third year of this program. Author

N93-21672# Wisconsin Univ., Milwaukee. Dept. of Mechanical Engineering.

INTERNAL STRUCTURE AND INTERFACIAL AREA IN TWO-PHASE FLOW SYSTEMS

G. Kojasoy 1991 121 p Presented at the USA-USSR Workshop on Multiphase Flow, Chicago, IL, 2-4 Oct. 1991

(Contract DE-FG02-87ER-13764)
(DE93-000921; DOE/ER-13764/10; CONF-9110429-1) Avail: CASI HC A06/MF A02

The interfacial transfer terms and the importance of the interfacial area concentration are reviewed first with respect to the two-fluid model formulation of two-phase flow systems. Then the available measurement techniques for interfacial area are reviewed. At present, it appears that various methods such as the chemical, light attenuation, photographic, ultrasound attenuation, and probe techniques have a number of limitations. Among these measurement techniques, however, the local probe method using one or more double sensors seems to have the greatest potential in terms of accuracy and wider applicability in various two-phase flow patterns. From the brief review of existing interfacial area modeling methods, it is concluded that the conventional approaches might not be sufficient, and new directions are indicated. Recent experimental results on local interfacial structural characteristics of horizontal bubbly two-phase flow and internal flow structure development are presented. More specifically, experimental results on local void fraction, interfacial area concentration, bubble size, bubble interface velocity, and bubble frequency are documented in detail. Finally, a theoretical model predicting the mean bubble size and interfacial area concentration is proposed. The theoretically predicted bubble size and interfacial area concentration are found to agree reasonably well with those measured by using a double-sensor resistivity technique. DOE

N93-21734# Los Alamos National Lab., NM.
HYDROPHOBIC EFFECTS FROM CAVITY STATISTICS
L. R. Pratt and A. Pohorille 1992 9 p Presented at the 1992 European Biophysical Society Workshop on Water on Water-Biomolecule Interactions, Palermo, Italy, Jun. 1992
(Contract W-7405-eng-36)
(DE93-003698; LA-UR-92-3260; CONF-9206312-1) Avail: CASI HC A02/MF A01

Given here is a simple introduction to the statistics characterizing spontaneous cavity formation in liquids. These statistical quantities provide helpful diagnostics of solvation in complex solutions, and it is recommended that their estimation be generally implemented in simulation of biomolecule systems. Examples show that the most probable cavities which occur in liquid water are not smaller than those which form in n-hexane. However, the cavities which form in liquid water constitute a narrower distribution than those in n-hexane or in a random medium of the same density. Even though these methods provide radial distributions of water near a hard sphere solute of high precision relative to more conventional calculations, still further theoretical treatment of the longer ranged behavior of these distributions will be required to extract fluctuation thermodynamic quantities such as the partial molar volume of the solute at infinite dilution. DOE

N93-21771# Los Alamos National Lab., NM.
BIBLIOGRAPHY GROUP T-3, 1955 - 1991
M. Findley Sep. 1992 43 p
(Contract W-7405-eng-36)
(DE93-002851; LA-12377-MS) Avail: CASI HC A03/MF A01

This bibliography includes all known unclassified publications by members of Group T-3 between 1955 and 1991. They principally describe or show extensive use of numerical computing methods for hydrodynamics problems developed by members of Group T-3. In particular, the listing refers to papers on the following topics: high-speed fluid dynamics, low-speed dynamics, all-speed dynamics, magnetodynamics and plasma physics, turbulence, reactive flows and sprays, dynamic response of materials, and general physics and mathematics. DOE

N93-21819*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
CROSSFLOW STABILITY AND TRANSITION EXPERIMENTS IN A SWEPT-WING FLOW Ph.D. Thesis
John Ray Dagenhart Dec. 1992 286 p Sponsored by NASA. Langley Research Center
(NASA-TM-108650; NAS 1.15:108650) Avail: CASI HC A13/MF A03

An experimental examination of crossflow instability and transition on a 45 degree swept wing is conducted in the Arizona State University Unsteady Wind Tunnel. The stationary-vortex pattern and transition location are visualized using both sublimating-chemical and liquid-crystal coatings. Extensive hot-wire measurements are conducted at several measurement stations across a single vortex track. The mean and travelling-wave disturbances are measured simultaneously. Stationary-crossflow disturbance profiles are determined by subtracting either a reference or a span-averaged velocity profile from the mean-velocity data. Mean, stationary-crossflow, and travelling-wave velocity data are presented as local boundary-layer profiles and as contour plots across a single stationary-crossflow vortex track. Disturbance-mode profiles and growth rates are determined. The experimental data are compared to predictions from linear stability theory. Author

N93-21953# Universitaet der Bundeswehr Muenchen, Neubiberg (Germany). Inst. fuer Raumfahrttechnik.
LIQUID OSCILLATIONS UNDER STRONG SURFACE TENSION IN A CIRCULAR CYLINDRICAL CONTAINER
Helmut F. Bauer 1991 47 p
(LRT-WE-9-FB-26-1991; ETN-93-92736) Avail: CASI HC A03/MF A01

Depending on the magnitude of excitation the liquid surface tension and the location of the contact line of the liquid surface to the solid container wall, the surface may exhibit an anchored edge. For such a stuck edge condition natural frequencies and response of the liquid were determined. They were found to be larger than those of the freely slipping edge and exhibit according to this resonances at high forcing frequencies. Author (ESA)

N93-21977# Lowell Univ., MA.
AN AXISYMMETRIC, TURBULENT FLOW ANALYSIS OF CONTAMINANT INFILTRATION INTO A PRESSURIZED STRUCTURE WITH A FABRIC ENDCAP Final Report, Jan. - Dec. 1990
Struan Robertson Nov. 1992 162 p
(Contract DAAK60-92-K-0001; DA Proj. 1L1-62786-A-427)
(AD-A259344; Natick-TR-93/008) Avail: CASI HC A08/MF A02

The problem of contaminant transport by turbulent flow and its infiltration into a fabric structure pressurized with uncontaminated air is studied for axisymmetric flow. A model for turbulent pipe flow having a concentric, pressurized chamber, with a fabric endcap, placed axially within the pipe is developed. Contaminated air enters the pipe and is transported down the pipe. Some of the contaminated air is transported through the fabric and is dispersed within the pressurized chamber. The effect of forcing uncontaminated air into the chamber on the infiltration and dispersion of contaminated air is studied. The particular formulation that is used in this study is the two-equation model of turbulence. The SIMPLER algorithm and code that were used in earlier laminar flow studies have been modified to incorporate the two-equation model. The fabric is considered to be passive. Comparisons with experimental results show that not all fabrics can be considered as passive because their properties change with the level of contamination. GRA

N93-22000# Sandia National Labs., Albuquerque, NM.
DIRECT SECOND KIND BOUNDARY INTEGRAL FORMULATION FOR STOKES FLOW PROBLEMS
L. A. Mondy and M. S. Ingber 1991 7 p Presented at the 11th International Congress of Rheology, Brussels, Belgium, 17-21 Aug. 1992
(Contract DE-AC04-76DP-00789)
(DE93-004069; SAND-91-2174C; CONF-920852-5) Avail: CASI HC A02/MF A01

In this paper we describe a DBEM for the Stokes problem which results in a Fredholm integral equation of the second kind. This is accomplished by deriving a boundary integral equation for the components of traction (TBIE). We examine the applicability and compare the accuracy of boundary element methods based on the VBIE and the TBIE for two example problems. These examples demonstrate the efficacy of the method of regularization of the hypersingular integrals and the method of constraining out the rigid body eigenmodes for the TBIE. This work also demonstrates the robust nature of the VBIE for these problems that require a moderate number of boundary elements. DOE

N93-20421# National Space Development Agency, Ibaraki (Japan). Thermal and Structural Engineering Lab.
RESEARCH ON TWO PHASE FLUID LOOP TYPE HEAT REJECTION TECHNOLOGY [NISOU RYUUTAI RUPUSHIKI HAINETSU GIJUTSU NO KENKYUU]
Haruaki Itagaki, Takanobu Yamamoto, Tooru Iida, and Yasuo Ishii *In its* Research and Development Activities of the Tsukuba Space Center Aug.

1992 p 53-56 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20431# National Space Development Agency, Ibaraki (Japan). Thermal and Structural Engineering Lab.
RESEARCH ON HOPE HEAT SINK DEVICE [HOPE NETSU SHINKU SOUCHI NO KENKYUU]
Haruaki Itagaki, Takanobu Yamamoto, Tooru Iida, and Yasuo Ishii *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 97-102 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A02/MF A03

N93-20617# British Columbia Univ., Vancouver. Dept. of Mechanical Engineering.
COMPUTATIONAL FLUID FLOW AND HEAT TRANSFER. AN ENGINEERING TOOL
Martha Salcudean *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 34-44 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20618# University Coll. of Swansea (Wales).
ADAPTIVITY-FLUIDS-LOCALIZATION. THE CHALLENGE TO COMPUTATIONAL MECHANICS
O. C. Zienkiewicz *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 46-53 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20622# Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
THE PRACTICAL APPLICATION OF COMPUTATIONAL FLUID MECHANICS
G. D. Raithby and P. F. Galpin (Advanced Scientific Computing Ltd., Waterloo, Ontario.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 78-81 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20629# McMaster Univ., Hamilton (Ontario). Dept. of Mechanical Engineering.
FLUID/STRUCTURE INTERACTIONS. INTERNAL FLOWS
D. S. Weaver *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 130-134 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20689# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
AN EXPERIMENTAL INVESTIGATION OF A ROUND TURBULENT JET IN A CROSS-FLOW
Z. Huang, J. G. Kawall, and J. F. Keffer *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 492-493 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20690# Windsor Univ. (Ontario). Civil and Environmental Engineering.
SPATIAL FORMULATION OF THE HEAT TRANSFER PROBLEM IN NONHOMOGENEOUS MEDIA
B. B. Budkowska and I. Kreja (Gdansk Technical Univ., Poland.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 530-531 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20691# Windsor Univ. (Ontario). Civil and Environmental Engineering.
TIME DEPENDENT FORMULATION OF THE HEAT TRANSFER PROBLEM IN NONHOMOGENEOUS MEDIA
B. B. Budkowska and I. Kreja (Gdansk Technical Univ., Poland.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 532-533 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-21087# Toronto Univ. (Ontario). Thermodynamics and Kinetics Lab.
STABILITY OF THE FLUID-FLUID INTERPHASE IN ROTATING SYSTEMS SUBJECTED TO DIFFERENT GRAVITATIONAL INTENSITIES
J. A. Wade, D. Yee, and C. A. Ward *In* Canadian Space Agency, Spacebound 1991 1991 p 79-84 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21089# Canadian Space Agency, Ottawa (Ontario).
ISOPYCNIC SYSTEMS AS MODELS FOR THE BEHAVIOR OF LIQUIDS IN A MICROGRAVITY ENVIRONMENT
Francois Quirion *In its* Spacebound 1991 1991 p 91-95 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21092# British Columbia Univ., Vancouver. Dept. of Pathology.
ORDERING OF AGGREGATING PARTICLE SUSPENSIONS UNDERGOING SIMPLE SHEAR
D. E. Brooks, A. Olal, and M. Bell *In* Canadian Space Agency, Spacebound 1991 1991 p 107-111 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21095# Saskatchewan Univ., Saskatoon. Dept. of Mechanical Engineering.
A VISUALIZATION STUDY OF THE DIFFUSION PROCESS BETWEEN TWO LIQUIDS OF DIFFERENT DENSITIES UNDER MICROGRAVITY CONDITIONS
J. Falk and K. Rezkallah *In* Canadian Space Agency, Spacebound 1991 1991 p 123-128 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21096# Toronto Univ. (Ontario). Dept. of Chemical Engineering.
QUENCHING OF A TUBE AND FILLING OF A VESSEL UNDER MICROGRAVITY
M. Kawaji, C. J. Westbye, and B. N. Antar (Tennessee Univ. Space Inst., Tullahoma.) *In* Canadian Space Agency, Spacebound 1991 1991 p 129-134 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

N93-20361# Carnegie-Mellon Univ., Pittsburgh, PA. School of Computer Science.
IMPLEMENTATION AND EVALUATION OF A THREE-DIMENSIONAL PHOTOMETRIC SAMPLER
Hideichi Sato, Shree K. Nayar, and Katsushi Ikeuchi Jul. 1992 55 p (Contract F33615-90-C-1465; ARPA Order 7597)
(AD-A258636; CMU-CS-92-148) Avail: CASI HC A04/MF A01

The photometric sampling method extracts shape and reflectance properties of surfaces (Lambertian, specular, and hybrid) by using multiple illumination directions and a single viewing direction. In this paper, we describe a complete implementation and a performance evaluation of a three-dimensional version of the photometric sampler. All existing shape extraction techniques that are based on photometric measurements rely on assumed surface reflection properties. We proposed a method for

determining the shape of surfaces whose reflectance properties may vary from Lambertian to specular without prior knowledge of the relative strengths of the Lambertian and specular components of reflection. The object surface is illuminated using extended light sources and is viewed from a single direction. Extended light sources make it possible to ensure the detection of both Lambertian and specular reflections. Extended sources are generated by illuminating a diffuser with a point source of light. In the 3D implementation of the photosampler, multiple extended sources are generated by distributing 36 point sources around a spherical diffuser, each light source is located at the vertex of a one-frequency icosahedron. GRA

N93-20569* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

SYSTEM FOR DETERMINING THE ANGLE OF IMPACT OF AN OBJECT ON A STRUCTURE Patent

William H. Prosser, investor (to NASA) and Michael R. Gorman, inventor (to Navy) 2 Mar. 1993 8 p Filed 17 Jun. 1992 Supersedes N93-17041 (31 - 5, p 1169)

(NASA-Case-LAR-14817-1; US-Patent-5,191,558; US-Patent-Appl-SN-903708; US-Patent-Class-367-124; Int-Patent-Class-G01S-3/80) Avail: US Patent and Trademark Office

A method for determining the angle of impact of an object on a thin-walled structure which determines the angle of impact through analysis of the acoustic waves which result when an object impacts a structure is presented. Transducers are placed on and in the surface of the structure which sense the wave caused in the structure by impact. The waves are recorded and saved for analysis. For source motion normal to the surface, the antisymmetric mode has a large amplitude while that of the symmetric mode is very small. As the source angle increases with respect to the surface normal, the symmetric mode amplitude increases while the antisymmetric mode amplitude decreases. Thus, the angle of impact is determined by measuring the relative amplitudes of these two lowest order modes. Official Gazette of the U.S. Patent and Trademark Office

N93-20769 Department of the Navy, Washington, DC.

UNINTERRUPTED, ENHANCED-RATE, EVENT-TIME RECORDER WITH MIXED-SPEED COUNTER MODULES Patent

Willard M. Cronyn, inventor (to Navy) 25 Aug. 1992 15 p Filed 9 Oct. 1991

(AD-D015578; US-Patent-5,142,651; US-Patent-Appl-SN-775678) Avail: US Patent and Trademark Office

An uninterrupted event-time recorder enables high-precision measurements of the time-of-occurrence of randomly- and rapidly-occurring, digitally specified events such as the leading and/or trailing edges of asynchronous pulses. The lowest order binary digits of the recorder are constructed of high-speed synchronous integrated circuit counter devices. For an N-bit timer having M low-order bits, the highest order (N-M) bit counting is executed by two parallel (N-M)-bit slow-speed counters, one of which is incremented by the terminal count of the M-bit high-speed counter and the other which is incremented by the most significant bit (MSb) of the M-bit counter. The (N-M)-bit counters are read out through a multiplexer controlled by the MSb. GRA

N93-20771 Department of the Navy, Washington, DC.

PRESSURE COMPENSATED TRANSDUCER SYSTEM WITH CONSTRAINED DIAPHRAGM Patent

Joseph L. Percy, inventor (to Navy) 18 Aug. 1992 7 p Filed 29 Jul. 1988

(AD-D015580; US-Patent-5,140,560; US-Patent-Appl-SN-227937) Avail: US Patent and Trademark Office

An acoustic source apparatus has an acoustic transducer that is enclosed in a substantially rigid and watertight enclosure to resist the pressure of water on the transducer and to seal the transducer from the water. The enclosure has an opening through which acoustic signals pass and over which is placed a resilient, expandable and substantially water-impermeable diaphragm. A net stiffens and strengthens the diaphragm as well as constrains the diaphragm from overexpansion or from migrating due to buoyancy forces. Pressurized gas, regulated at slightly above ambient pressure, is supplied to the enclosure and the diaphragm to compensate for underwater ambient pressures. Gas pressure regulated at above ambient pressure is used to selectively tune the pressure levels within the enclosure and diaphragm so that diaphragm resonance can be achieved. Controls are used to selectively fill, as well as vent the enclosure and diaphragm during system descent and ascent, respectively. A signal link is used to activate these controls and to provide the driving force for the acoustic transducer. GRA

N93-20855# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).

A CRYOGENIC SHUTTER FOR THE VLT NIR CAMERA [KRYOGENER SHUTTER FUER DIE NIR-KAMERA AM VLT]

Franz-Josef Schoeniger Mar. 1992 97 p In GERMAN

(MPE-237; ETN-93-92595) Copyright Avail: CASI HC A05/MF A02

For the Very Large Telescope (VLT) Near Infrared (NIR) camera, a cryogenic shutter was developed for a 12 mm wide beam path with a 5 ms switching time and a 75 mW rate of power input. The control software was modified for use in the NIR camera. In the case where no parallel interface is available at the control computer, a control slide is provided for, on which a microprocessor produces the control signal for the sequence. The new shutter concept shows great advantages over the previous scanner drive of the SHARP (System for High Angular Resolution Pictures) camera. The stepping motor causes notably less vibrations than the scanner drive and less power consumption. ESA

N93-20927# Stockholm Univ. (Sweden). Dept. of Meteorology.

ACCURATE PROCEDURE FOR CALIBRATING THE CAO OPTICAL HYGROMETER

Joerg Gumbel, Urs Waelchli, and Marina Kretova (Central Aerological Observatory, Dolgoprudnyi, USSR.) 4 May 1992 33 p Sponsored in part by ESA

(AP-30; ETN-93-93058) Avail: CASI HC A03/MF A01

Two hygrometers of the Central Aerological Observatory (CAO) (Russia) were calibrated with respect to the partial pressure of water vapor. Optical hygrometers from the CAO are designed for measuring water vapor at heights above 10 km. They use the fluorescence at a wavelength near 310 nm of excited OH molecules produced in the photolysis of water molecules by ultraviolet radiation at wavelengths below 137 nm. The pressure gauges used with the vacuum system were calibrated for water vapor and nitrogen. The overall uncertainty of the experimental procedure is 42 percent. The application of these results to data measured in the atmosphere is discussed. In order to check the preflight calibration, a postflight calibration of the equipment was also performed. The setup of the calibration system consists of a mass spectrometer, a Bayard-Alpert gauge, and a Baratron sensor. ESA

N93-20932# Aerospatiale, Paris (France).

THE HOLOGRAPHIC INTERFEROMETRY: AN INDUSTRIAL TOOL

J. Bouteyre (Aerospatiale Aquitaine, Saint-Medard en Jalles, France.) and C. LeFloch (Aerospatiale Aquitaine, Saint-Medard en Jalles, France.) 1992 9 p

(Rept-921-430-110; ETN-93-91938) Avail: CASI HC A02/MF A01

The pressurant tank testing facility which uses holographic interferometry is considered. Details of different parts of the pressurant tanks (liner, wrapping, and sizing pressure) are given. Nondestructive studies are described and examples of resulting holographic interferograms are given. A general description of the holographic nondestructive facility is also given. ESA

N93-21039# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Inst. fuer Physik der Atmosphaere.

DROP SIZING WITH THERMAL ANEMOMETRY: A REVIEW [TROPFENGROESSENBESTIMMUNG MITTELS THERMISCHER ANEMOMETRIE: EINE UEBERSICHT]

Thomas Hauf and Gesa Neumann-Hauf Aug. 1991 31 p

(DLR-Mitt-91-18; ETN-93-91918) Avail: CASI HC A03/MF A01; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

A literature survey on papers dealing with drop sizing by means of thermal anemometry is given. The main focus is on water drops in air, for example in clouds. Problems related to the subject are also discussed. The fundamentals of hot film and hot wire techniques are discussed with emphasis on two way flows. Conclusions for the planned development of an airborne drop sizing instrument are drawn. ESA

N93-21247# ELDEC Corp., Lynnwood, WA.
SMART INTEGRATED MICROSENSOR SYSTEM (SIMS) Final Report, Oct. 1987 - Feb. 1992
Mel Fujita Nov. 1992 43 p
(Contract DAAJ02-89-C-0038)
(AD-A259430; USAAVSCOM-TR-92-D-4) Avail: CASI HC A03/MF A01

This report details the design and development of the Smart Integrated Microsensor System (SIMS). SIMS is a sensor that measures fatigue in materials and components and displays it in an easy-to-understand readout. GRA

N93-21251# Midwest Research Inst., Golden, CO.
PRINCIPLES AND APPLICATIONS OF MEASUREMENT AND UNCERTAINTY ANALYSIS IN RESEARCH AND CALIBRATION
C. V. Wells Nov. 1992 19 p Presented at the 3rd Annual Infrared Radiometric Sensor Calibration Symposium, Logan, UT, 14-17 Sep. 1992
(Contract DE-AC02-83CH-10093)
(DE93-000034; NREL/TP-411-5165; CONF-9209271-1) Avail: CASI HC A03/MF A01

Interest in Measurement Uncertainty Analysis has grown in the past several years as it has spread to new fields of application, and research and development of uncertainty methodologies have continued. This paper discusses the subject from the perspectives of both research and calibration environments. It presents a history of the development and an overview of the principles of uncertainty analysis embodied in the United States National Standard, ANSI/ASME PTC 19.1-1985, Measurement Uncertainty. Examples are presented in which uncertainty analysis was utilized or is needed to gain further knowledge of a particular measurement process and to characterize final results. Measurement uncertainty analysis provides a quantitative estimate of the interval about a measured value or an experiment result within which the true value of that quantity is expected to lie. Years ago, Harry Ku of the United States National Bureau of Standards stated that 'The informational content of the statement of uncertainty determines, to a large extent, the worth of the calibrated value.' Today, that statement is just as true about calibration or research results as it was in 1968. Why is that true? What kind of information should we include in a statement of uncertainty accompanying a calibrated value? How and where do we get the information to include in an uncertainty statement? How should we interpret and use measurement uncertainty information? This discussion will provide answers to these and other questions about uncertainty in research and in calibration. The methodology to be described has been developed by national and international groups over the past nearly thirty years, and individuals were publishing information even earlier. Yet the work is largely unknown in many science and engineering arenas. I will illustrate various aspects of uncertainty analysis with some examples drawn from the radiometry measurement and calibration discipline from research activities. DOE

N93-21265# Defence Research Establishment Suffield, Ralston (Alberta).
MOTION AND STRUCTURE ESTIMATION OF MANOEUVRING OBJECTS IN MULTIPLE-CAMERA IMAGE SEQUENCES
Victor C. Aitken Nov. 1992 146 p
(AD-A259371; DRES-SR-577) Avail: CASI HC A07/MF A02

Estimation of structure and six-degree-of-freedom motion of maneuvering objects through measurements of feature positions in long, multiple-camera image sequences is widely recognized to have broad industrial, military, and space applications, particularly in the control of autonomous systems. This report focuses on removing restrictive assumptions concerning the mode of translational and rotational motion which are commonly employed in many existing methods. Object maneuvers, being smooth and time correlated, are modelled as first-order Gauss-Markov processes for both translational and rotational motion. In the literature, rotational motion is often parameterized with unit quaternions even though constraints on the quaternion norm are not easily enforced, roll-pitch-yaw parameterizations were reported to be poorly behaved and have led to computationally demanding implementations. Results using the Euler angle-axis parameterization in recursive motion and structure estimation are not available. In this report, six-degree-of-freedom, nonlinear, approximate state estimation filters for quaternion, roll-pitch-yaw, and angle-axis parameterizations are compared in terms of estimation performance for maneuvering object trajectories. Special consideration is given to the problem of imposing unit norm on the estimated quaternion since previously proposed methods led to filter instability, particularly in angular velocity estimation. GRA

N93-21461# GKSS-Forschungszentrum Geesthacht (Germany). Inst. fuer Physik.
COMPARISON OF THE MEASUREMENTS OF TEMPERATURE AND SENSIBLE HEAT FLOW WITH AN ULTRASONIC ANEMOMETER-THERMOMETER AND A TEMPORAL HIGH RESOLUTION PLATINUM WIRE-RESISTANCE THERMOMETER Thesis - Fachhochschule Hamburg [VERGLEICH MESSUNGEN VON TEMPERATUR UND SENSIBLEM WAERMEFLUSS MIT EINEM ULTRASCHALL-ANEMOMETER-THERMOMETER UND EINEM ZIETLICH HOCHAUFLOESENDEN PLATINDRAHT-WIDERSTANDSTHERMOMETER]
M. Behrendt 1992 118 p In GERMAN
(GKSS-92/E/11; ETN-93-93396) Copyright Avail: CASI HC A06/MF A02

High resolution temperature data from the atmospheric surface layer was analyzed. Data was obtained by a sonic anemometer thermometer and a fast platinum wire sensor. Turbulence measurements gathered during two field experiments were analyzed by means of statistical methods, in order to characterize the time response of the temperature sensor. Sonic power spectra calculated using the fast Fourier transformation did not show the theoretically expected spectral behavior in the high frequency range. The spectral curves were found to depend on the wind speed and direction, whereas spectra for the fast temperature sensor showed the expected spectral slopes. The comparison of second order moments for the two sensors revealed an attenuation of the signal of the fast temperature sensor. ESA

N93-21652# Institute of Gas Technology, Chicago, IL.
SENSOR TECHNOLOGY FOR INTERNAL INSPECTION SYSTEMS Report, Nov. 1990 - Nov. 1991
Bruce K. Campbell and Jeffrey E. Stafford Jul. 1992 103 p Sponsored by Gas Research Institute
(Contract GRI-5089-271-2082)
(PB93-101020; GRI-92/0248) Avail: CASI HC A06/MF A02

The Institute of Gas Technology (IGT) designed, fabricated, and tested a breadboard acoustic receiver module as one car of several on the Gas Research Institute (GRI) MOUSE. The acoustic receiver will be used to pinpoint gas leaks from within the pipe by detecting the leak sound and analyzing it as a function of MOUSE location in the pipe. Because gas leaks create sound that gets louder as the receiver approaches the leak, the MOUSE may accurately locate leaks rapidly and inexpensively. The first-year effort demonstrated laboratory feasibility to locate simulated leaks of about 60 SCF/h. Both condenser microphones and piezoelectric film were mounted inside a MOUSE car and its ability to detect leaks was tested. Phase 1 successfully demonstrated that the breadboard acoustic sensor locates leaks in no line flow conditions by recording sound amplitude changes in specific frequency ranges, while operating in conjunction with the GRI MOUSE. Some flow tests indicated that flow noise was substantial and may hamper leak pinpointing in high line flow situations. IGT recommends more critical examination of flow noise and leak sensitivity issues for acoustic sensors. GRA

N93-21704# Allied-Signal Aerospace Co., Kansas City, MO.
AUTOMATED CONNECTOR FORCE TESTING
L. A. Timmons Nov. 1992 50 p
(Contract DE-AC04-76DP-00613)
(DE93-004634; KCP-613-4869) Avail: CASI HC A03/MF A01

A gaging system was developed to modernize the force testing of electrical connectors and components using an IBM personal computer based data acquisition system. Two mechanical fixtures were fabricated using load cells and LVDT transducers to perform the measurements. General purpose software routines perform the operator interface, data acquisition, storage, retrieval, and printout. The system will perform statistical analysis of the part data to aid in evaluation of the manufacturing process. The modular software concept allows the system to be tailored for many other applications using a text editor. DOE

N93-21816*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
TOTAL TEMPERATURE PROBES FOR HIGH-TEMPERATURE HYPERSONIC BOUNDARY-LAYER MEASUREMENTS
Cindy W. Albertson and Willard A. Bauserman, Jr. Mar. 1993 34 p (RTOP 506-43-21-01)
(NASA-TM-4407; L-17124; NAS 1.15:4407) Avail: CASI HC A03/MF A01

The design and test results of two types of total temperature probes that were used for hypersonic boundary-layer measurements are presented. The intent of each design was to minimize the total error and to maintain minimal size for measurements in boundary layers 1.0 in. thick and less. A single platinum-20-percent-rhodium shield was used in both designs to minimize radiation heat transfer losses during exposure to the high-temperature test stream. The shield of the smaller design was flattened at the flow entrance to an interior height of 0.02 in., compared with 0.03 in. for the larger design. The resulting vent-to-inlet area ratios were 60 and 50 percent. A stainless steel structural support sleeve that was used in the larger design was excluded from the smaller design, which resulted in an outer diameter of 0.059 in., to allow closer placement of the probes to each other and to the wall. These small design changes to improve resolution did not affect probe performance. Tests were conducted at boundary-layer-edge Mach numbers of 5.0 and 6.2. The nominal free-stream total temperatures were 2600 degrees and 3200 degrees R. The probes demonstrated extremely good reliability. The best performance in terms of recovery factor occurred when the wire-based Nusselt number was at least 0.04. Recommendations for future probe designs are included.
Author (revised)

N93-20148*# Sandia National Labs., Albuquerque, NM.
PORTABLE FIBER OPTIC COUPLED DOPPLER INTERFEROMETER SYSTEM FOR DETONATION AND SHOCK WAVE DIAGNOSTICS
Kevin J. Fleming *In* NASA. Stennis Space Center, The First NASA Aerospace Pyrotechnic Systems Workshop Jan. 1993 p 257-273 (For primary document see N93-20132 07-28)
(SAND-92-1359C) Avail: CASI HC A03/MF A04

N93-20152*# Sandia National Labs., Albuquerque, NM. Explosive Projects and Diagnostics.
EXPLOSIVE COMPONENT ACCEPTANCE TESTER USING LASER INTERFEROMETER TECHNOLOGY
Richard D. Wickstrom and William W. Tarbell *In* NASA. Stennis Space Center, The First NASA Aerospace Pyrotechnic Systems Workshop Jan. 1993 p 375-395 (For primary document see N93-20132 07-28)
(SAND-92-0324C) Avail: CASI HC A03/MF A04

N93-20449# National Space Development Agency, Ibaraki (Japan). Common Equipment Lab.
RESEARCH ON SATELLITE-BORNE HIGH SPEED DATA RECORDER [TOUSAIGATA KOUSOKU DETA REKODA NO KENKYUU]
Satoru Yamamoto, Hiroshi Anegawa, and Masahiro Kasuya *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 177-182 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A02/MF A03

N93-20451# National Space Development Agency, Ibaraki (Japan). Common Equipment Lab.
MANUFACTURE OF ADEOS BORNE TECHNICAL DATA ACQUISITION EQUIPMENT Report No. 1 [ADEOS TOUSAIYOU GIJUTSU DETA SHUTOKU SOUCHI NO SEISAKU]
Hironobu Nishimoto and Haruhisa Matsumoto *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 187-190 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20489# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.
OUTLINE OF SCM DATA PROCESSING SYSTEM ONBOARD ETS-5 [ETS-5 SCM DETA SHORI SHISUTEMU NO GAIYOU]
Sumio Matsuda, Takashi Tamura, and Masato Uesugi *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 335-336 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20515*# Gates Aerospace Batteries, Gainesville, FL.
RELIABILITY STUDY OF THE NiH2 STRAIN GAGE
Glenn C. Klein and Donald E. Rash, Jr. (Reliability Analysis Center, Rome, NY.) *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 553-56 (For primary document see N93-20490 07-44)
Avail: CASI HC A03/MF A06

N93-20725# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
FREQUENCY RATIO LOCK UP IN THE ATTITUDE DRIFT OF A DISSIPATIVE AXISYMMETRIC GYROSTAT
A. Kessaris and F. P. J. Rimrott *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 748-749 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-21083# Thomson and Nielsen Electronics, Ottawa (Ontario).
DIRECT-READING DOSIMETERS FOR SPACE LIFE SCIENCE EXPERIMENTS
I. Thomson and G. Mackay *In* Canadian Space Agency, Spacebound 1991 1991 p 63-68 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21084# Bubble Technology Industries, Inc., Chalk River (Ontario).
BUBBLE DETECTORS FOR THE MEASUREMENT OF SPACE RADIATION
H. Ing, K. Tremblay, A. Mortimer (Canadian Space Agency, Ottawa, Ontario.), E. E. Kovalev (Research Center of Space Craft Radiation Safety, Moscow, Russia.), V. E. Dudkin (Research Center of Space Craft Radiation Safety, Moscow, Russia.), A. M. Marenny (Research Center of Space Craft Radiation Safety, Moscow, Russia.), and N. A. Nefedov (Research Center of Space Craft Radiation Safety, Moscow, Russia.) *In* Canadian Space Agency, Spacebound 1991 1991 p 69-71 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21911# Thermedics, Inc., Woburn, MA.
CALIBRATION METHODS FOR EXPLOSIVES DETECTORS
Stephen J. MacDonald and David P. Rounbehler *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 584-588 (For primary document see N93-21856 07-03)
Avail: CASI HC A01/MF A10

N93-21912# Amerasia Technology, Inc., Westlake Village, CA.
VAPOR DETECTION USING SAW SENSORS
Gary Wayne Watson, W. Horton, and Edward Jerome Staples, Jr. *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 589-603 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

N93-21914# Brigham Young Univ., Provo, UT. Dept. of Chemistry.
ATMOSPHERIC PRESSURE IONIZATION TIME-OF-FLIGHT MASS SPECTROMETER FOR REAL-TIME EXPLOSIVES VAPOR DETECTION
Harold G. Lee, Edgar D. Lee, and Milton L. Lee *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 619-633 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

N93-21915# Scientech, Inc., Idaho Falls, ID.
REAL-TIME EXPLOSIVES/NARCOTICS VAPOR ENHANCEMENT AND COLLECTION SYSTEMS FOR USE WITH THE ATMOSPHERIC PRESSURE IONIZATION TIME-OF-FLIGHT MASS SPECTROMETER
M. Marx Hintze, Byron L. Hansen, and Russell L. Heath *In* FAA, Proceedings of the First International Symposium on Explosive Detection

Technology May 1992 p 634-636 (For primary document see N93-21856 07-03)
Avail: CASI HC A01/MF A10

N93-21930# Diametrix Corp., San Diego, CA.
DRY IMMUNOCHEMICAL SENSOR FOR THE DETECTION OF PETN VAPOR
Herbert Richard Lukens *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 753-758 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

N93-21932# Naval Research Lab., Washington, DC. Center for Bio/Molecular Science and Engineering.
THE FLOW IMMUNOSENSOR: AN ANTIBODY-BASED SYSTEM FOR EXPLOSIVES DETECTION
Anne W. Kusterbeck, Frances S. Ligler, and James P. Whelan (Geo-Centers, Inc., Fort Washington, MD.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 770-773 (For primary document see N93-21856 07-03)
Avail: CASI HC A01/MF A10

N93-21934# Science Applications International Corp., Santa Clara, CA.
BOMB/NO BOMB: FROM MULTIVARIATE ANALYSIS TO ARTIFICIAL NEURAL SYSTEMS
Patrick Shea, Felix Liu, and Barak Yedidia *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 777-786 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

N93-21940# Sandia National Labs., Albuquerque, NM.
SEGMENTATION OF X RAY IMAGES USING PROBABILISTIC RELAXATION LABELING
Tan Q. Thai *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 860-871 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

N93-21941# Carnegie-Mellon Univ., Pittsburgh, PA. Robotics Inst.
ROBOTIC SYSTEMS FOR DEPLOYMENT OF EXPLOSIVE DETECTION SENSORS AND INSTRUMENTS
Melvin W. Siegel, A. M. Guzman, and W. M. Kaufman *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 873-879 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N93-20005# Tactical Weapons Guidance and Control Information Analysis Center, Chicago, IL.
LASER DAMAGE IN THIN FILM OPTICAL COATINGS State of the Art Review, 1984 - 1989
Kent J. Kogler Jul. 1992 134 p
(Contract DLA900-86-C-0022)
(AD-A259425; GACIAC-SOAR-91-01) Avail: CASI HC A07/MF A02

A review of laser damage resistant coatings for optical elements to be employed in military systems using lasers or encountering lasers used as weapons or countermeasures is provided. It provides an extensive data base of damage thresholds for oxide, fluoride, and chalcogenide single layer and multilayer coatings. The data base is supported by a detailed description of how the coatings were synthesized and how the measurements were performed to collect the damage threshold data. The basis from which the information was collected covers a period from 1984 through 1989. The material reviewed includes investigation of causes of damage in optical coatings and approaches to reducing or eliminating damage mechanisms with the objective of raising damage thresholds. The information should be found useful in selecting coating materials and techniques for their synthesis or as a tool in evaluating the susceptibility of existing coated optical elements. GRA

N93-20020# Lawrence Livermore National Lab., CA.
EXAMINATION OF LASER CONDITIONING USING ATOMIC FORCE MICROSCOPY
A. Tesar, M. Balooch, R. Tench, C. Stolz, T. Sarginson, and W. Siekhaus Jan. 1992 13 p Presented at the SPIE International Society for Optical Engineering Meeting, Boulder, CO, 23-25 Oct. 1991
(Contract W-7405-eng-48)
(DE93-001328; UCRL-JC-108124; CONF-911064-11) Avail: CASI HC A03/MF A01

The modification of an optical coating surface with laser exposure at fluences below the damage threshold resulted in localized minimization of asperities. Topological changes with time were mapped using an atomic force microscope. It is suggested that charge accumulation on the dielectric coating drives the surface morphology to higher uniformity. DOE

N93-20246# Institute for Defense Analyses, Alexandria, VA.
IDA GAMMA RAY LASER: INVESTIGATION OF THE FEASIBILITY OF DEVELOPING A LASER USING NUCLEAR TRANSITIONS Annual Summary Report, 1989
Bohdan Balko, Irvin W. Kay, John Neuberger, and Gary Herling Apr. 1992 136 p
(Contract MDA903-89-C-0003)
(AD-A259476; IDA-P-2335; IDA/HQ-90-35218) Avail: CASI HC A07/MF A02

The Haake-Reibold model of superfluorescence is generalized to take into account certain effects that, while negligible for atomic emission, are important for the nuclear case. Comparisons are made of three different approaches to numerical computation based on the model, and a number of explicit calculations are made to illustrate the behavior of the emitted pulse under various conditions. In addition, detailed analyses of the effects of homogeneous broadening and relaxation on superfluorescent emission are presented. GRA

N93-20262# Department of the Navy, Washington, DC.
PULSE DISCHARGE LASER WITH PASSIVE ARC PROTECTION Patent Application
Mark Bashkansky, inventor (to Navy) and Bernard Wexler, inventor (to Navy) 30 Sep. 1992 25 p
(AD-D015601; US-Patent-Appl-SN-953605; Navy-Case-71961) Avail: CASI HC A03/MF A01

A pulse discharge laser is provided having a pair of electrodes disposed within a laser chamber pressurized with a high-pressure gas. A preionizer generator intermittently produces preionization energy to preionize the high pressure gas in the laser chamber. A pulse forming network intermittently supplies a ramping voltage to the pair of electrodes. When the high pressure gas in the laser chamber is not properly preionized by the preionization energy, a damaging arc may occur and lasing will not occur by discharge of the ramping voltage on the electrodes. A passive electrode arc protector is provided connected across the pair of laser electrodes to discharge the ramping voltage across the electrodes when the high pressure gas is not properly preionized to protect the laser electrodes from a damaging arc between them. GRA

N93-20284 Drexel Univ., Philadelphia, PA.
TRANSVERSE EFFECTS IN A MODEL OF SEMICONDUCTOR LASER ARRAYS Ph.D. Thesis
Thomas Frederick All Bibby, Jr. 1992 293 p
Avail: Univ. Microfilms Order No. DA9237885

We present the results of an investigation of spatially non-uniform excitation on the operating characteristics of a semiconductor laser array. The array is modeled as a homogeneously broadened, two-level system in a ring resonator configuration with non-uniform gain in the transverse direction. The dynamical behavior of the two-level system is governed by the Maxwell Bloch equations, which we restrict to the mean field limit. We found that spatial modulation causes a shift in the threshold value of gain by a factor of 1/(D(sub eq)), where the angle brackets represent spatial averaging, and D(sub eq) is the equilibrium population profile, i.e., it represents the spatial modulation. We also found that the intensity changes by a factor of (D(sub eq)). Fourier expansion of the dynamical variables

leads to a set of equations of motion of the modal amplitudes. Numerical solutions of these equations showed that a single mode often dominates. We call this Stationary Single Mode (SSM) operation. We obtained an expression for a SSM intensity by solving the equations of motion of the modal amplitudes in steady state in the presence of spatial modulation. Analysis of this equation revealed conditions for modal selection at first threshold, and the range of parameter values for which specific modes can exist. We conclude by discussing these results in the context of the practical requirements of a semiconductor laser theory which takes into account transverse effects. Dissert. Abstr.

N93-20286 Kent Univ., Canterbury (England).
THE SEMICONDUCTOR LASER APPLIED TO FIBRE OPTIC SENSORS Ph.D. Thesis
J. H. Midgley 1991 259 p
Avail: Univ. Microfilms Order No. BRDX97462

Semiconductor lasers are being increasingly applied to optical fibre communications and optical fibre sensor systems. This thesis is chiefly concerned with the latter use and particularly the behavior of the semiconductor lasers employed in such sensor systems when subjected to feedback from both within and without the coherence length of the solitary source. Following an exploration of the use of semiconductor laser diodes in an all fiber LTV system where there is no requirement for good spectral quality, a cheap semiconductor laser pigtailing technique is developed with the intention of using these devices in LTV and other fiber optic sensor systems. The problem of mode hopping in pigtailed laser diodes induced by butt cleaved fiber feedback is explored and a novel solution is suggested and proved experimentally which naturally leads on to a full study of the semiconductor laser subject to instrumental feedback. A model of the semiconductor laser known as the Van der Pol oscillator under generalized weak feedback is developed to produce novel expressions for the laser center frequency when undergoing coherent optical feedback from outside the solitary source coherence length and fringe visibility for interferometers sourced by semiconductor lasers undergoing incoherent optical feedback. These expressions are explored experimentally with the intention of determining the optical feedback isolation requirements for diode lasers employed in fiber based sensor systems. In the course of these developments a previously unreported regime of semiconductor laser behavior is investigated in which the laser is simultaneously subject to both coherent and incoherent feedback, with new semiconductor laser parameters such as the 'returned incoherent persistence of field factor' and the 'partial returned coherent fraction' being introduced.
Dissert. Abstr.

N93-20298*# American Univ., Washington, DC. Dept. of Physics.
INJECTION SEEDED, DIODE PUMPED REGENERATIVE RING Nd:YAG AMPLIFIER FOR SPACEBORNE LASER RANGING TECHNOLOGY DEVELOPMENT
D. Barry Coyle, Richard B. Kay, John J. Degnan (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.), Danny J. Krebs (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.), and Bernard D. Seery (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.) [1992] 16 p
(Grants NAG5-1319; NSG-50333)
(NASA-CR-192171; NAS 1.26:192171) Avail: CASI HC A03/MF A01

A small, all solid state, regenerative ring amplifier designed as a prototype for space application is discussed. Novel features include dual side pumping of the Nd:YAG crystal and a triangular ring cavity design which minimizes the number of optical components and losses. The amplifier is relatively small (3 ns round trip time) even though standard optical elements are employed. The ring regeneratively amplifies a 100 ps single pulse by approximately 10(exp 5) at a repetition rate of 10 to 100 Hz. The amplifier is designed to be injection seeded with a pulsed, 100 ps laser diode at 1.06 microns, but another Nd:YAG laser system supplying higher pulse energies was employed for laboratory experiment. This system is a prototype laser oscillator for the Geoscience Laser Ranging System (GLRS) platform. Results on measurements of beam quality, astigmatism, and gain are given. Author

N93-20365# California Univ., Berkeley. Dept. of Electrical Engineering and Computer Science.
ULTRAFAST DYNAMICS OF QUANTUM WELL LASERS: ULTIMATE POTENTIAL FOR HIGH SPEED MODULATION Annual Report
Kam Y. Lau Sep. 1992 2 p
(AD-A258653) Avail: CASI HC A01/MF A01

In the past year, we have concentrated our activities on obtaining a fundamental understanding of the role of carrier transport in quantum well lasers in their high speed modulation characteristics. For the past decade, it has been assumed that such transport effects are too fast to be of substantial consequence. Not until the past year did we begin to understand that intrinsic quantum capture of carriers into the quantum well, which occurs on a sub-picosecond time scale, has a severe effect on the modulation of quantum well lasers in the tens of gigahertz range. The effects are particularly severe in lower dimensional quantum materials. Through a combination of experimental and theoretical studies we are uncovering the physics behind these effects. GRA

N93-20608# Air Force Inst. of Tech., Wright-Patterson AFB, OH. Foreign Aerospace Science and Technology Center.
LASER SCRIBING SYSTEM FOR AMORPHOUS SILICON SOLAR CELLS
Youliang Wang, Yaling Shi, Xiaorong Su, Shuming Yan, and Hong Xu 7 Jan. 1993 13 p Transl. into ENGLISH from Yingyong Jiguang (China), v. 11, no. 3, Jun. 1991 p 110-114
(AD-A259287; FASTC-ID(RS)T-0315-92) Avail: CASI HC A03/MF A01

In this paper, we describe a laser scribing system for the fabrication of a-Si solar cells. Additionally, we provide a theoretical analysis of the system. The system was used to scribe the TCO and a-Si films. GRA

N93-20745# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany). Abt. Messphysik.
CALIBRATION OF THE IMAGING CONDITIONS FOR THE RETRANSFORMATION OF DIGITIZED IMAGES OBTAINED FROM LASER LIGHT SHEETS [KALIBRIERUNG VON AUFNAHMEKONFIGURATIONEN ZUR RUECKTRANSFORMATION DIGITALISIERTER LICHTSCHNITTAUFNAHMAN]
Bernd Leitl Jan. 1992 29 p In GERMAN
(DLR-Mitt-92-04; ETN-93-92406) Avail: CASI HC A03/MF A01

It is shown that it is possible to measure geometrical parameters of visualized and digitized flow structures using the laser light sheet method and digital image processing. A calibration and transformation algorithm is presented which makes it possible to transform image coordinates into world coordinates. This algorithm can be applied to a great number of different problems on account of its high accuracy. The quality of the calibration and transformation program TRAKO is demonstrated using test cases. ESA

N93-20770 Department of the Navy, Washington, DC.
METHOD AND APPARATUS FOR GENERATING FRAUNHOFER LINE LASER SOURCE USING STIMULATED RAMAN SCATTERING Patent
Daniel L. Katz, inventor (to Navy) 25 Aug. 1992 5 p Filed 16 May 1991
(AD-D015579; US-Patent-5,142,645; US-Patent-Appl-SN-701394) Avail: US Patent and Trademark Office

The present invention provides an apparatus and method for generating blue laser light having a wavelength corresponding to a solar Fraunhofer line. The blue laser light is at a frequency that has both excellent transmissibility through sea water and a high signal-to-noise ratio. A first laser beam, generated using an injection-locked excimer XeCl laser, is down-converted by a first-Stokes order shift of 2 x 4155 /cm 1/ in a first Raman cell containing H2 gas at a pressure of about 10 atmospheres. The output of the first Raman cell is down-converted by a first Stokes shift of 3628/cm in a second Raman cell containing HD/ at a pressure of about 10 atmospheres so that the output of the second Raman cell has a wavelength of 486.366 nm. This wavelength corresponds to the FE I solar Fraunhofer line. GRA

N93-20804# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany). Zentrale Technologieforschung.
MICROSTRUCTURED DIODE LASERS AND PUMPED SOLID STATE LASERS Abstract Only [MIKROSTRUKTURIERTE DIODENLASER-GEPUMPTE FESTKOERPERLASER]

Peter Peuser, Stefan Heinemann, Axel Mehnert, and Nikolaus-P. Schmitt 1991 3 p In GERMAN Presented at VDI-Fachausschuss Mikrosystemtechnik, Stuttgart-Buesnau, Germany, 16 Jan. 1991
(MBB-Z-0369-91-PUB; ETN-93-92748) Avail: CASI HC A01/MF A01

The properties of diode lasers are reviewed and compared with characteristics of solid state lasers. Diode, transfer optics, laser crystal, microchannel cooling, optical diagnosis elements and sensors, mechanical actuators, and regulation electronics are integrated on a substrate. The power area of these lasers varies by up to a few watts to several kilowatts and wavelengths are possible from the visible light to infrared. The diode lasers allow a better radiation quality, divergence and line width, higher pulse power, and better frequency stability. Laboratory experiments show that the miniaturization gives very interesting laser properties. ESA

N93-20843# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).
A HIGH EFFICIENCY CW HOLMIUM-DOPED FLUOROZIRCONATE FIBRE LASER AT 1.19 MICROMETERS
H. Toebben (Technische Univ., Brunswick, Germany.) and Ludwig Wetencamp 1992 4 p Presented at Optical Society of America/IEEE/Lasers and Electro-Optics Society Conference on Advanced Solid-State Lasers, Santa Fe, NM, 17-19 Feb. 1992
(MBB-Z-0414-91-PUB; ETN-92-92754) Avail: CASI HC A01/MF A01

A high power Continuous Wave (CW) laser is presented which is thought to be the first Ho(3+) laser lasing at 1.9 micrometers. An experiment to measure its pumping efficiency and output power is described. The lasing characteristics of the fiber emitting at 1.19 micrometers are illustrated graphically. The laser emission spectrum at 300K pumped with 490 mW at 639 nm, and at 77K pumped with 290 mW at 639 nm are presented. The absorption spectra at both temperatures are discussed. It is concluded that improvement of the results should be possible by optimization of the doping concentration, reflectivity of the output mirror, fiber geometry and fiber length. ESA

N93-20881# Technische Univ., Berlin (Germany). Fachbereich Elektrotechnik.
MODULATION BEHAVIOR OF SEMICONDUCTOR LASERS WITH OPTICAL FEEDBACK Ph.D. Thesis [MODULATIONSVERHALTEN HALBLEITERLASERN BEI OPTISCHER RUECKWIRKUNG]
Jochen Helms 1992 125 p In GERMAN
(ETN-93-92567) Avail: CASI HC A06/MF A02

Modulation behavior is systematically examined. Dimensioning and operation are considered with regard to system aspects. The equation system is extended to a semiconductor laser with external optical feeding. The development of external resonator modes is described. The noise intensity and the noise frequency of the unmodulated laser with optical feedback is examined using the equation system in order to determine the stable field of work and the limit of the analytical model. The harmonic distortions of second order and the intermodulation distortions of third order are calculated for two extremely adjacent frequency modulations using a perturbation analysis. The physical results obtained with regard to SubCarrier Multiplex (SCM) systems and phased array antennas are evaluated. ESA

N93-20916# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).
EFFICIENT CW OPERATION OF A 2.75 MICROMETER Er(3+)-DOPED FLUOROZIRCONATE FIBRE LASER PUMPED AT 650 AND 795 NM
Ludwig Wetenkamp (Technische Univ., Brunswick, Germany.) 1991 6 p Repr. from AEU, v. 45, no. 5, 1991 p 329-332
(MBB-Z-0384-91-PUB; ETN-92-92752) Avail: CASI HC A02/MF A01

Results of an efficient tunable Continuous Wave (CW) laser operation of an Er(3+)-doped ZBLAN multimode fiber laser, emitting within the range 2.67 to 2.83 microns, achieved by optical pumping at 650 and 795 nm, are presented. Thresholds lay below 1 mW absorbed power for both pumping wavelengths. Slope efficiencies and maximum output powers were 3.3 percent and 19.4 mW at 650 nm, and 4.3 and 7.9 mW at 795 nm, respectively. Laser operation was also achieved without an output mirror, that is, using reflection at the fiber end. The threshold value at 795 nm was 110 mW, with a slope efficiency of 9.2 percent and maximum output of 20 mW. At 650 nm values were 197 mW, 5.8 percent and 26 mW, respectively. ESA

N93-21016# National Oceanic and Atmospheric Administration, Boulder, CO. Wave Propagation Lab.
FREQUENCY CONVERSION OF A CO2 LASER WITH ZnGeP2
J. H. Churnside, J. J. Wilson, A. I. Gribenyukov (Academy of Sciences, USSR, Tomsk.), S. F. Shubin (Academy of Sciences, USSR, Tomsk.), S. I. Dolgii (Academy of Sciences, USSR, Tomsk.), Y. M. Andreev (Academy of Sciences, USSR, Tomsk.), and V. V. Zuev (Academy of Sciences, USSR, Tomsk.) Jul. 1992 24 p
(PB92-222785; NOAA-TM-ERL-WPL-224) Avail: CASI HC A03/MF A01

The authors achieved frequency doubling and quadrupling of CO2 laser radiation using ZnGeP2 crystals. Frequency tripling was unsuccessfully attempted. Absorption, phase-matching considerations, conversion efficiency, and damage thresholds are discussed. The authors obtained 26 percent conversion efficiency in doubling and 0.04 percent in quadrupling. GRA

N93-21175# Technische Hochschule, Darmstadt (Germany). Fachbereich Physik.
CONFIGURATION AND CONSTRUCTION OF A FREE ELECTRON LASER IN NEAR INFRARED AT THE SUPERCONDUCTING ELECTRON ACCELERATOR IN DARMSTADT (GERMANY) Ph.D. Thesis [AUSLEGUNG UND KONSTRUKTION EINES FREIE-ELEKTRONEN-LASERS IM NAHEN INFRAROTEN AM SUPRALEITENDEN DARMSTAEDTER ELEKTRONENBESCHLEUNIGER]
Klaus Alrutz-Ziemssen 1990 109 p In GERMAN
(ETN-93-93412) Avail: CASI HC A06/MF A02

The parameters of the superconducting electron accelerator are reported. The operation of a Free Electron Laser (FEL) in such an installation and the modifications of the accelerator to be carried out for the operation of a FEL, are examined. A new injection concept is designed, with which peak current intensities of 2.7 A can be obtained for a pulse repeat frequency of 10 MHz. An adapted hybrid undulator is designed based on the selection of electron radiation energy in a range between 35 to 50 MeV and in the corresponding wave length of the FEL in near infrared. The computations were carried out numerically, and using the relations from the linear small signal amplification of the FEL. Results from both methods were in good agreement. ESA

N93-21267# Naval Research Lab., Washington, DC.
ASSESSMENT OF SINGLE-PULSE LASER DAMAGE TO STRUCTURAL MATERIALS FOR SPACECRAFT
F. R. Stonesifer, P. W. Randles, and J. A. Nemes 24 Dec. 1992 27 p
(AD-A259387; NRL/MR/6386-92-7179) Avail: CASI HC A03/MF A01

Laser radiation damage to structural or shielding materials can occur by several quite different mechanisms. For continuous-wave and repetitively-pulsed radiation, the damage was found to be primarily thermal. However, for a single laser pulse of very high intensity and short duration, spalling and mechanical damage become the principal failure mechanism and time does not allow extensive thermal degradation. In exposure of opaque materials to a high-energy short-duration laser pulse, an expanding plasma is formed on the material surface and a mechanical pulse is transmitted into the remaining target material. This compression wave, attenuated by the target material, reflects off the free or low impedance boundary at the back surface as a tension wave. If conditions are favorable, both front and back faces may spall causing complete penetration of the material. The magnitude of the dynamic stress pulse is dependent on intensity, wave length, and pulse duration as well as the target-material properties and thickness. A discussion of pressure/impulse, wave attenuation, and spallation is presented. Equations are developed. Experimental data available in the literature, from both flyer-plate and laser shock tests, are plotted and compared for various classes of thin structural materials. GRA

N93-21352# SRI International Corp., Menlo Park, CA. Molecular Physics Lab.
LASER PROBES OF NATURAL GAS IGNITION CHEMISTRY Annual Report, Jan. - Dec. 1991
David R. Crosley, David M. Golden, and Gregory Smith Mar. 1992 30 p
(Contract GRI-5087-260-1444; SRI Proj. 3092)
(PB92-227776; SRI-MP-92-054; GRI-92/0215) Avail: CASI HC A03/MF A01

The research, funded by the Physical Sciences Department of the Gas

Research Institute, is aimed at developing and using laser-induced fluorescence of various hydrocarbon species as a probe in natural gas combustion research and at developing an understanding of the chemical mechanisms of ignition and burning of natural gas. Studies were made of infrared degenerate four-wave mixing, flow patterns in a low-pressure burner, and the OH + CO and OH + CH3 reactions. Thermodynamic data and the pressure dependence of rate constants important in the PSST natural gas mechanism collaboration were evaluated. GRA

N93-21709# Rice Univ., Houston, TX.
INFRARED TUNABLE DIFFERENCE FREQUENCY LASER SOURCE
R. F. Curl 1992 8 p
(Contract DE-FG05-90ER-75585)
(DE93-005128; DOE/ER-75585/2) Avail: CASI HC A02/MF A01

The equipment necessary to construct an infrared laser source based on difference frequency generation in AgGaS2 was purchased. This continuous wave, single frequency, tunable infrared source was assembled and is being used for infrared kinetic spectroscopy of small free radicals important in combustion. Infrared spectra are given for the Q-branch of a combination band (11(sup 1)1) of N2O, and for the transient in CO produced by flash photolysis of acetone in various vibrational states. DOE

N93-21744# Texas A&M Univ., College Station. Transportation Inst.
USE OF RADAR TECHNOLOGY FOR PAVEMENT LAYER EVALUATION
Ken R. Maser (Infrasense, Inc., Cambridge, MA.), Tom Scullion, and R. C. Briggs (Texas Highway Dept., Austin.) Feb. 1991 32 p Revised Sponsored by Texas Highway Dept.
(PB92-226166; TTI-2-18-88-930; RR-930-5F; FHWA/TX-91/930-5F) Avail: CASI HC A03/MF A01

The use of non-contract Ground Penetration Radar to measure asphalt surfacing thicknesses at speeds ranging from 5 to 40 mph is described. On four Strategic Highway Research Program (SHRP) sites in Texas, it was determined that by using radar alone it was possible to predict asphalt thicknesses to + or - 7.6mm (0.32 inches). The accuracy in predicting granular base thickness was + or - 25mm (0.99 inches). The impact of using actual layer thicknesses on falling weight deflectometer analysis is demonstrated. Author (revised)

N93-21770# Ames Lab., IA.
MACROSCOPIC SURFACE CLEANING USING A HIGH REPETITION RATE ULTRAVIOLET LASER
H. M. Pang, D. Baldwin, and M. C. Edelson 1992 3 p Presented at the IEEE Lasers and Electro-Optics Society Meeting, Boston, MA, 15-20 Nov. 1992
(Contract W-7405-eng-82)
(DE93-002545; IS-M-730; CONF-9211142-1) Avail: CASI HC A01/MF A01

The aim of the Ames Laboratory Laser Decontamination Project is to explore new decontamination methods to reduce waste volumes and achieve sufficiently high decontamination factors to permit the unrestricted release of metals for commercial use. This paper presents a discussion of recent experimental work designed to test the capabilities of ultraviolet lasers for large surface area (approximately m(sup 2)) cleaning. The potential benefits of applying laser technology to decontamination are the elimination of solvents, the potential for remote operation to reduce exposure of personnel and expensive equipment to radiation hazards, and the minimization of secondary wastes. High-repetition rate lasers can clean large surfaces (approximately m(sup 2)) in a reasonable amount of time. Proper selection of laser pulse energy, wavelength, repetition rate, and focusing lens is mandated to optimize process efficiency. DOE

N93-21952 Stanford Univ., CA.
ULTRAFAST LASER GENERATION OF HARD X RAYS Ph.D. Thesis
Jeffrey Dellert Kmetec 1992 88 p
Avail: Univ. Microfilms Order No. DA9234124

This dissertation describes the efficient production of hard x-rays from a laser-produced-plasma, and the construction of the driving laser. More than 0.3 percent of the incident laser energy is converted to x-radiation between 20 and 300 keV, although the spectrum extends beyond 1 MeV. These results are obtained by focusing a 60 mJ, 120 fsec, 807 nm laser, operated at a 5 Hz repetition rate, to greater than 10(exp 18) W/sq cm onto a solid tantalum target. The x-ray spectrum is determined by measuring the transmission of various metal filters, using a calibrated 25 mm NaI detector as a calorimeter. This data is well fit by assuming that the x-ray spectral distribution is described by a 1/energy function. By limiting the solid angle collected by the NaI detector to 1.2 mu-ster and filtering the x-rays with 19 mm of lead, single photon pulse height analysis is achieved. This data indicates that the x-ray spectrum falls faster than 1/energy at high (greater than 350 KeV) photon energies, yet a characteristic temperature or spectral cut-off has not been observed. More than 100 micro-J of hard x-rays are emitted from an expected 500 micron region in less than 1 psec. Greater than 10(exp 6) photons above 1 MeV are generated with each shot. The laser technology is sufficiently economical that the x-ray source described here will become a significant laboratory tool, allowing many laboratories to use x-ray pulses that are shorter and brighter than ever before available. Dissert. Abstr.

N93-21955# Argonne National Lab., IL. Advanced Photon Source Accelerator Systems Div.
COMMENTS ON ADVANCED, TIME-RESOLVED IMAGING TECHNIQUES FOR FREE-ELECTRON LASER (FEL) EXPERIMENTS
A. H. Lumpkin 1992 30 p Presented at the 14th International Free Electron Laser Conference, Kobe, Japan, 23-28 Aug. 1992
(Contract W-31-109-eng-38)
(DE93-002897; ANL/ASD/CP-76106; CONF-9208142-11) Avail: CASI HC A03/MF A01

An extensive set of time-resolved imaging experiments has been performed on rf-linac driven free-electron lasers (FELs) over the past few years. These experiments have addressed both micropulse and macropulse timescales on both the charged-particle beam and the wiggler/undulator outputs (spontaneous emission and lasing). A brief review of first measurements on photoinjecter micropulse elongation, submacropulse phase slew in drive lasers, submacropulse wavelength shifts in lasers, etc. is presented. This is followed by discussions of new measurements of 35-MeV electron beam micropulse bunch length (less than 10 ps) using optical transition radiation, some of the first single bend synchrotron radiation beam profile measurements at gamma less than 80, and comments on the low-jitter synchroscan streak camera tuner. These techniques will be further developed on the 200-650 MeV linac test stand at the Advanced Photon Source (APS) in the next few years. Such techniques should be adaptable to many of the present FEL designs and to some aspects of the next generation of light sources. DOE

N93-21969# Los Alamos National Lab., NM.
SIMULTANEOUS OPERATION OF A FREE-ELECTRON LASER ON TWO HARMONICALLY RELATED WAVELENGTHS
A. T. Burke, S. K. Ride, M. J. Schmitt, and J. C. Goldstein 1992 17 p Presented at the 14th International Free Electron Laser Conference, Kobe, Japan, 23-28 Aug. 1992
(Contract W-7405-eng-36)
(DE93-003745; LA-UR-92-3441; CONF-9208142-14) Avail: CASI HC A03/MF A01

The interaction of light waves at the fundamental and the third harmonic frequencies in a free-electron laser (FEL) oscillator is explored using the 1-D finite pulse mode-code BFELP. The code, which assumes that only the TEM(sub 00) transverse mode is present at both harmonic frequencies, tracks the temporally-finite pulse electric field amplitudes of the fundamental and the third harmonic which interact with an rf-linac-generated electron micropulse inside a wiggler. The evolution of the pulse profiles, with possibly different mirror reflectivities at each frequency, after many passes through the wiggler and the optical resonator, was generated for various initial conditions. Results include pulse-dependent third-harmonic coherent-spontaneous emission (CSE) with, and without, multiple-pass interference effects; the effects of sidebands at the fundamental on third-harmonic CSE; and lasing competition between the fundamental and third harmonic in overlapping spatial regions of the electron micropulse. DOE

N93-20100*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
DEVELOPMENT OF A 100 mJ, 5 Hz, FLASHLAMP-PUMPED, Cr,Tm:YAG COHERENT LIDAR TRANSMITTER
S. Henderson (Coherent Technologies, Inc., Boulder, CO.) and S. Johnson *In its* NASA/MSFC FY92 Earth Science and Applications Program Research

Review Jan. 1993 p 107 (For primary document see N93-20067 07-47)
Avail: CASI HC A01/MF A02

N93-20101*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
MULTI-CENTER AIRBORNE COHERENT ATMOSPHERIC WIND SENSOR (MACAWS)
Jeffry Rhothermel, W. D. Jones, J. A. Dunkin, and E. W. McCaul, Jr. (Universities Space Research Association, Huntsville, AL.) *In its* NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 109-110 (For primary document see N93-20067 07-47)
Avail: CASI HC A01/MF A02

N93-20106*# Alabama Univ., Huntsville. Center for Applied Optics.
COMPUTER MODELING OF PULSED CO2 LASERS FOR LIDAR APPLICATIONS
Gary D. Spiers *In* NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 121-124 (For primary document see N93-20067 07-47)
Avail: CASI HC A01/MF A02

N93-20465# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.
REVIEW ON OPTICAL ELEMENTS FOR INTERSATELLITE LASER COMMUNICATION [EISEIKAN REZA TSUUSHINYOU HIKARI SOSHI NO CHOUSA KENKYUU]
Takashi Tamura, Tooru Kanno, and Mitsuhiro Nakamura *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 243-246 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-21126# Ecole Polytechnique, Montreal (Quebec).
DISCUSSION OF THE OPTICAL EFFECTS CREATED BY A LASER SOURCE ON PARTICLES UNDER MICROGRAVITY [DISCUSSION DES EFFETS OPTIQUES CREES PAR UNE SOURCE LASER SUR DES PARTICULES EN MICROGRAVITE]
Jean-Marie Gagne and Francois Babin *In* Canadian Space Agency, Spacebound 1991 1991 p 289-294 In FRENCH (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21127# MPB Technologies, Inc., Sainte-Anne-de-Bellevue (Quebec).
PROGRESS IN THE DEVELOPMENT OF THE LASER-BASED R/D TEST-BED SYSTEM Abstract Only
M. Olivier, S. Simard, A. Laferriere, L. Audet, P. Langlois (National Optics Inst., Ste-Foy, Quebec.), and E. Harvey (National Optics Inst., Ste-Foy, Quebec.) *In* Canadian Space Agency, Spacebound 1991 1991 p 295 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21408*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
COHERENT DOPPLER LIDAR FOR AUTOMATED SPACE VEHICLE RENDEZVOUS, STATIONKEEPING AND CAPTURE Abstract Only
James A. Bilbro *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 6 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21409*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
VIDEO GUIDANCE SENSOR Abstract Only
Richard Howard *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 6 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21410*# Rockwell International Corp., Seal Beach, CA.
APPROACH RANGE AND VELOCITY DETERMINATION USING LASER SENSORS AND RETROREFLECTOR TARGETS Abstract Only
William J. Donovan *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 6-7 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21422*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A COMPARISON OF LASER-BASED RANGING SYSTEMS FOR AR/C Abstract Only
Stephen J. Katzberg and Pleasant W. Goode, IV *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 15-16 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N93-19978*# Radiation Monitoring Devices, Inc., Watertown, MA.
A PROTOTYPE NOVEL SENSOR FOR AUTONOMOUS, SPACE BASED ROBOTS, PHASE 2 Final Report No. 9, 2 Mar. 1988 - 2 Jul. 1990
M. R. Squillante, L. P. deRochemont, L. Cirignano, P. Lieberman, and M. S. Soller Jul. 1990 38 p
(Contract NAS7-1032; SBIR-05.01-1167)
(NASA-CR-191344; NAS 1.26:191344) Avail: CASI HC A03/MF A01

The goal of this program was to develop new sensing capabilities for autonomous robots operating in space. Information gained by the robot using these new capabilities would be combined with other information gained through more traditional capabilities, such as video, to help the robot characterize its environment as well as to identify known or unknown objects that it encounters. Several sensing capabilities using nuclear radiation detectors and backscatter technology were investigated. The result of this research has been the construction and delivery to NASA of a prototype system with three capabilities for use by autonomous robots. The primary capability was the use of beta particle backscatter measurements to determine the average atomic number (Z) of an object. This gives the robot a powerful tool to differentiate objects which may look the same, such as objects made out of different plastics or other light weight materials. In addition, the same nuclear sensor used in the backscatter measurement can be used as a nuclear spectrometer to identify sources of nuclear radiation that may be encountered by the robot, such as nuclear powered satellites. A complete nuclear analysis system is included in the software and hardware of the prototype system built in phase 2 of this effort. Finally, a method to estimate the radiation dose in the environment of the robot has been included as a third capability. Again, the same nuclear sensor is used in a different operating mode and with different analysis software. Each of these capabilities are described. Author

N93-20004# Alphatech, Inc., Burlington, MA.
INCIPIENT FAILURE DETECTION USING WAVELETS Final Report, 20 Apr. - 31 Oct. 1992
Robert R. Tenney, Alonso E. Rhenals, James C. Deckert, and Alan S. Willsky Dec. 1992 55 p
(Contract N00014-92-C-0040)
(AD-A259423; TR-565) Avail: CASI HC A04/MF A01

The feasibility of incipient fault detection for vibrating systems not only for bench test conditions (helicopter gearbox) but also for mild operating conditions (condensate and fire pumps) is demonstrated. Only one of the several available data channels from the multiple accelerometers mounted on the case of each equipment type was employed. A continuous wavelet transform (CWT), based on the Kiang wavelet, to select features for an artificial neural network (ANN) classifier was used. The CWT provided enough visibility into the fault signals to allow the reduction of the size of the feature set to 10 - 15 features. A low-dimensional, conventional ANN classifier with rejection of ambiguous classifications was used. A 0.000 probability of false alarm, 0.000 probability of missed detection, and less

than 0.04 probability of deferral (to a subsequent feature vector) for all three data sets was achieved. The major product is a single methodology to identify robust features that lead to these performance levels. GRA

N93-20007# Alphatech, Inc., Burlington, MA.
WAVELET FEATURES FOR FAILURE DETECTION AND IDENTIFICATION IN VIBRATION SYSTEMS Final Report, 30 May - 30 Nov. 1992
James C. Deckert, Alonso E. Rhenals, Robert R. Tenney, and Alan S. Willsky Dec. 1992 76 p
(Contract DAAH01-92-C-R300)
(AD-A259427; TR-567) Avail: CASI HC A05/MF A01

The result of this effort is an extremely flexible and powerful methodology for failure detection and identification (FDI) in vibrating systems. The essential elements of this methodology are: (1) an off-line set of techniques to identify high-energy, statistically significant features in the continuous wavelet transform (CWT); (2) a CWT-based preprocessor to extract the most useful features from the sensor signal; and (3) simple artificial neural networks (incorporating a mechanism to defer any decision if the current feature sample is determined to be ambiguous) for the subsequent classification task. For the helicopter intermediate gearbox test-stand data and centrifugal and fire pump shipboard (mild operating condition) data used, the algorithms designed using this method achieved perfect detection performance (1.000 probability of detection, and 0.000 false alarm probability), with a probability less than 0.04 that a decision would be deferred-based on only 500 milliseconds of data from each sample case. While this effort shows the exceptional promise of our wavelet-based method for FDI in vibrating systems, more demanding applications, which also have other sources of high-energy vibration, raise additional technical issues that could provide the focus for a Phase 2 effort. GRA

N93-20117* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
ROBOT-FRIENDLY CONNECTOR Patent
George F. Parma, inventor (to NASA), Mark H. Vandeberghe, inventor (to NASA), and Steve C. Ruiz, inventor (to NASA) 2 Mar. 1993 13 p Filed 26 Nov. 1991 Supersedes N92-23544 (30 - 14, p 2382)
(NASA-Case-MSC-21864-1; US-Patent-5,190,932;
US-Patent-Appl-SN-799460; US-Patent-Class-403-171;
US-Patent-Class-403-176; US-Patent-Class-403-353;
US-Patent-Class-403-381; US-Patent-Class-52-465;
Int-Patent-Class-F16B-1/04) Avail: US Patent and Trademark Office

Robot friendly connectors, which, in one aspect, are truss joints with two parts, a receptacle and a joint, are presented. The joints have a head which is loosely inserted into the receptacle and is then tightened and aligned. In one aspect, the head is a rounded hammerhead which initially is enclosed in the receptacle with sloppy fit provided by the shape, size, and configuration of surfaces on the head and on the receptacle.
Official Gazette of the U.S. Patent and Trademark Office

N93-20120* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
METHOD AND APPARATUS FOR PRELOADING A JOINT BY REMOTELY OPERABLE MEANS Patent
Jon B. Kahn, inventor (to NASA) 16 Mar. 1993 8 p Filed 1 Jun. 1992 Supersedes N92-30540 (30 - 21, p 3659)
(NASA-Case-MSC-21940-1; US-Patent-5,193,929;
US-Patent-Appl-SN-892072; US-Patent-Class-403-14;
US-Patent-Class-403-404; US-Patent-Class-403-273;
US-Patent-Class-403-321; Int-Patent-Class-B25G-3/00) Avail: US Patent and Trademark Office

The invention is a method and apparatus for joining structures, an active structure and a passive structure, and imposing a tensile pre-load on the joint by a remotely operable mechanism comprising a heat contractible joining element. The method and apparatus include mounting on the structure, a probe shaft of material which is transformable from an expanded length to a contracted length when heated to a specific temperature range. The shaft is provided with a probe head which is receivable in a receptacle opening formed in the passive structure, when the active structure is moved into engagement therewith by an appropriate manipulator mechanism. A latching system mounted on the structure adjacent to the receptacle opening captures the probe head, when the probe head is inserted a predetermined amount. A heating coil on the shaft is energizable by remote control for heating the shaft to a temperature range which transforms the shaft to its contracted length, whereby a latching shoulder thereof engages latching elements of the latching system and imposes a tensile preload on the structural joint. Provision is also made for manually adjusting the probe head on the shaft to allow for manual detachment of the structures or manual preloading of the structural joint.
Official Gazette of the U.S. Patent and Trademark Office

N93-20399# Department of the Army, Washington, DC.
HATCH SECURING MECHANISM Patent Application
Robert K. Culling, inventor (to Army) 25 Sep. 1992 25 p
(AD-D015613; US-Patent-Appl-SN-949915) Avail: CASI HC A03/MF A01

The invention is a hatch securing mechanism having a base attached to a hatchway and a hasp attached to a hatch lid. The base has an apertured retainer and a pinway element, the hasp being held between the retainer and pinway element during closure of the lid. A latch pin translatable in the pinway element has an angled tip which slides against a bevelled surface of the hasp to force the hasp into tighter, locked engagement with the base. The latch pin has a helical groove segment about the pin's axis, and a stud fixed to the pinway element engages the groove segment. The interaction of the stud and groove segment effects translation of the latch pin when the pin is manually rotated. The action of the latch pin also compresses an elastically deformable seal between the door and door frame so that the seal is increasingly effective against explosive blast pressures. The invention includes a lock mechanism for keeping the latch pin in a hasp retaining position unless the pin is manually moved. GRA

N93-20759*# Maryland Univ., College Park. Inst. for Systems Research.
FLEX-GEARS Semiannual Report
Lung-Wen Tsai and Jonathan Peritt Jan. 1993 22 p
(Grant NAG5-2004)
(NASA-CR-192364; NAS 1.26:192364) Avail: CASI HC A03/MF A01

Flex-Gears are being developed as an alternative to brushes and slip rings to conduct electricity across a rotating joint. Flex-Gears roll in the annulus of sun and ring gears for electrical contact while maintaining their position by using a novel application of involute gears. A single Flex-Gear is predicted to transfer up to 2.8 amps, thereby allowing a six inch diameter device, holding 30 Flex-Gears, to transfer over 80 amps. Semi-rigid Flex-Gears are proposed to decrease Flex-Gear stress and insure proper gear meshing. Author

N93-20772 Department of the Navy, Washington, DC.
APPARATUS FOR REDUCTION OF VIBRATION IN LIQUID-INJECTED GAS COMPRESSOR SYSTEM Patent
Harry J. Skruch, inventor (to Navy) and John R. Ward, inventor (to Navy) 22 Sep. 1992 6 p Filed 17 Jun. 1991
(AD-D015607; US-Patent-Appl-SN-718322) Avail: US Patent and Trademark Office

An apparatus for reducing high vibration and pulsation levels generated by the discharge of gas-liquid mixtures from compressors is presented. A tuyere is positioned within the compressor housing to separate the gas from the liquid. GRA

N93-20776 Department of the Navy, Washington, DC.
IN-LINE HYDRAULIC DASHPOT Patent
Paul E. Moody, inventor (to Navy) 6 Oct. 1992 6 p Filed 25 Mar. 1991 Supersedes N92-11356 (30 - 2, p 244), AD-D014955
(AD-D015528; US-Patent-5,152,211; US-Patent-Appl-SN-674638;
US-Patent-Class-91-410) Avail: US Patent and Trademark Office

An in-line hydraulic dashpot is disclosed that effectively decelerates the piston of a power cylinder by controllably choking off the oil which is providing pressure to the piston. The in-line hydraulic dashpot of the invention includes a valve spool member movable between an open and closed position along a fluid flow path that supplies oil to the power cylinder. An actuator rod is cooperative with the valve spool member and the piston shaft of the power cylinder to move tile valve spool member between its open and closed positions. The in-line hydraulic dashpot eliminates the clashing of mechanical parts and therewith eliminates the noise that would

otherwise be generated thereby. The in-line hydraulic dashpot of the present invention makes possible the adaptation of a fixed stroke power cylinder to applications that call for a variable stroke length. GRA

N93-20790 Department of the Navy, Washington, DC.
SINGLE SCREW INTERRUPTED THREAD POSITIVE DISPLACEMENT MECHANISM Patent
Wayne W. Boblitt, inventor (to Navy) 14 Jul. 1992 9 p Filed 17 Jul. 1991
(AD-D015596; US-Patent-5,129,800; US-Patent-Appl-SN-731233) Avail: US Patent and Trademark Office

A single screw positive displacement compressor mechanism employing shallow gate rotor tooth penetration of the main rotor for purposes of reducing internal leakage and consequent compressor inefficiencies is presented. The invention is provided with an interrupted main rotor thread for purposes of insuring multiple gate rotor teeth meshing with the drive portion of the main rotor thread, thereby reducing gate rotor tooth flank loads in the compressor section of the device. Provision is also made for main rotor thread baffling between the main rotor chamber section and the mechanism inlet. GRA

N93-20877# Technische Univ., Berlin (Germany). Fachbereich Verkehrswesen.
HIGHER FREQUENCY TRANSMISSION PROPERTIES OF MOTOR CAR-CHASSIS SYSTEMS Ph.D. Thesis [HOEHERFREQUENTE UEBERTRAGUNGSEIGENSCHAFTEN DER KRAFTFAHRZEUG-FAHRWERKSYSTEME]
Tong Zhang 1992 292 p In GERMAN
(ETN-93-92563) Avail: CASI HC A13/MF A03

The transmission properties of motor car systems are analytically examined in a broad frequency range (up to 200 Hz), using a multibody system, containing rigid and elastic bodies. Most typical motor car variants used in the automobile industry were qualitatively modeled and their global power transmission behavior was analyzed with regard to various geometric shapes. A detailed transmission investigation was represented in connection with the assembly transmission tire total car system. The modal parameters were set up by theoretical finite element calculation and by experimental modal analysis of real chassis components. The higher frequency dynamic property of the hydraulic shock absorber was obtained by a real dynamic measurement. Its various modeling possibilities were discussed. ESA

N93-20918*# Catholic Univ. of America, Washington, DC. Dept. of Electrical Engineering.
TESTING OF ROMPS ROBOT MECHANICAL INTERFACES AND COMPLIANT DEVICE Semiannual Progress Report
Charles C. Nguyen and Sami S. Antrazi Mar. 1993 107 p
(Grant NAG5-1415)
(NASA-CR-192617; NAS 1.26:192617) Avail: CASI HC A06/MF A02

The Robot Operated Materials Processing System (ROMPS) has been developed at Goddard Space Flight Center (GSFC) under a flight project to investigate commercially promising in-space material processes and to design reflyable robot automated systems to be used in the above processes for low-cost operations. The ROMPS is currently scheduled for flight in 1994 as a Hitchhiker payload in a Get Away Special (GAS) can. An important component of the ROMPS is a three degree-of-freedom (DOF) robot which will be responsible for carrying out the required tasks of in-space processing of selected materials. This report deals with testing of the mating capability of the ROMPS robot fingers with its various mechanical interfaces. In particular, the test plan will focus on studying the capability of a compliance mechanism mounted on the robot fingers in accommodating misalignments between the robot fingers and the interfaces during the mating. The report is organized as follows: Section 2 represents the main components of the ROMPS robot and briefly describes its operations. Section 3 presents the objectives of the test and outlines the test plan. The testbed comprising a Steward Platform-based high precision manipulator and associated data acquisition and control systems is described in Section 4. Section 5 presents results of numerous experiments conducted to study the mating capability of the robot fingers with its various interfaces under misalignments. The report is concluded with observations and recommendations based on the test results. Author

N93-20958# Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse (France).
A MODULAR STRUCTURE FOR THE CONTROL OF AN AUTONOMOUS MOBILE ROBOT Ph.D. Thesis - Toulouse Univ.
Victor-Olivier Perebaskine 1992 156 p In FRENCH; ENGLISH summary Sponsored by Matra Marconi Space, France
(LAAS-92137; ETN-93-92727) Avail: CASI HC A08/MF A02

A hierarchically organized robot control structure is described. Four steps were achieved: characterization of the basic element types composing the functional layer, and identification of interaction modes between the different components of the control structure; specification and implementation of specific communication mechanisms to support these interaction modes in the control structure; study of the module structure, and its control; implementation of the system and validation by several experiments. One of the major aspects of this system is the possibility to program the robot's reactivity according to the mission requirements. Another important aspect is the ability to modify the relationships between modules during mission execution. ESA

N93-21005# Ecole Centrale de Lyon (France). Lab. de Mecanique des Fluides et d'Acoustique.
NUMERICAL SIMULATION OF THE INTERNAL AERODYNAMIC IN THE COMBUSTION CHAMBER OF THE RECIPROCATING ENGINES USING A FINITE ELEMENT METHOD Ph.D. Thesis [SIMULATION NUMERIQUE PAR ELEMENTS FINIS DE L'AERODYNAMIQUE INTERNE DES CHAMBRES DE COMBUSTION DES MOTEURS A PISTON]
M. Mao Yu 1990 171 p In FRENCH
(ECL-90-014; ETN-93-91946) Avail: CASI HC A08/MF A02

A numerical code using the finite element method with a moving mesh to simulate the flow structure inside the cylinder of a reciprocating combustion engine is presented. A simplified finite element method with a moving mesh to solve the Navier-Stokes equations was deduced from a general moving finite element method. Turbulence models for compressible subsonic flows are introduced and compared. The code was used to predict the turbulent flow inside the combustion chamber of a reciprocating engine during the intake and the compression strokes. The numerical results are in good agreement with the experimental data. The numerical method is concluded to be well adapted for the simulation of the complex flow inside the combustion chamber. ESA

N93-21171# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
THE COMPLEXITY OF THE FREE SPACE FOR A ROBOT MOVING AMIDST FAT OBSTACLES
A. F. vanderStappen, D. Halperin (Tel-Aviv Univ., Israel.), and M. H. Overmars Feb. 1992 20 p Sponsored by Netherlands Organization for Scientific Research
(Contract EEC-3075)
(RUU-CS-92-05; ETN-93-92805) Avail: CASI HC A03/MF A01

A version of the general motion planning problem for robot autonomy is considered. The complexity of motion planning algorithms depends highly on the complexity of the robot's free space. Theoretically, the complexity of the free space can be very high, resulting in bad worst case time bounds for motion planning algorithms. In practice, the complexity of the free space tends to be much smaller than the worst case complexity. Motion planning algorithms with a running time that is determined by the complexity of the free space therefore become feasible in practical situations. A definition of fatness is given and compared to a few alternatives. Under some realistic assumptions, the complexity of the free space of a robot with any fixed number of degrees of freedom moving around in a d dimensional Euclidean workspace with fat obstacles is shown to be linear in the number of obstacles. ESA

N93-21254# United Technologies Corp., East Hartford, CT.
ADVANCED TURBINE DESIGN FOR COAL-FUELED ENGINES
N. S. Bornstein 17 Jul. 1992 29 p
(Contract DE-AC21-89MC-26052)
(DE93-000224; DOE/MC-26052/3140) Avail: CASI HC A03/MF A01

The objective of this task is to perform a technical assessment of turbine blading for advanced second generation PFBC conditions, identify specific problems/issues, and recommend an approach for solving any problems identified. A literature search was conducted, problems associated

with hot corrosion defined and limited experiments performed. Sulfidation corrosion occurs in industrial, marine and aircraft gas turbine engines and is due to the presence of condensed alkali (sodium) sulfates. The principle source of the alkali in industrial, marine and aircraft gas turbine engines is sea salt crystals. The principle source of the sulfur is not the liquid fuels, but the same ocean born crystals. Moreover deposition of the corrosive salt occurs primarily by a non-equilibrium process. Sodium will be present in the cleaned combusted gases that enter the PFBC turbine. Although equilibrium condensation is not favored, deposition via impaction is probable. Marine gas turbines operate in sodium chloride rich environments without experiencing the accelerated attack noted in coal fired boilers where condensed chlorides contact metallic surfaces. The sulfates of calcium and magnesium are the products of the reactions used to control sulfur. Based upon industrial gas turbine experience and laboratory tests, calcium and magnesium sulfates are, at temperatures up to 1500 F (815 C), relatively innocuous salts. In this study it is found that at 1650 F (900 C) and above, calcium sulfate becomes an aggressive corrodent. DOE

N93-21658# Technical Research Centre of Finland, Espoo. Electrical and Automation Engineering Lab.

ANALYSIS OF FAILURE AND MAINTENANCE EXPERIENCES OF MOTOR OPERATED VALVES IN A FINNISH NUCLEAR POWER PLANT [MOOTTORITOIMISTEN VENTTIILIEN VIKA- JA KORJAUSTIETOJEN ANALYSOINTI YDINVOIMALAITOKSESSA]

Kaisa Simola and Kari Laakso Jan. 1992 202 p Sponsored by Ministry of Trade and Industry and Nordic Industrial Fund

(VTT-Tied-1322; ISBN-951-38-4054-9; ETN-93-93066) Copyright Avail: CASI HC A10/MF A03

Eight years of operating experiences of 104 motor operated closing valves in different safety systems in nuclear power units were analyzed in a systematic way. The qualitative methods used were Failure Mode and Effect Analysis (FMEA) and Maintenance Effects and Criticality Analysis (MECA). These reliability engineering methods are commonly used in the design stage of equipment. The successful application of these methods for analysis and utilization of operating experiences was demonstrated. ESA

N93-21667# Kansas Corp. Commission, Topeka.

FIRST INTERNATIONAL ALTERNATIVE FUELED VEHICLE ROUND-UP

1992 14 p

(Contract DE-FG47-80CS-62018)

(DE93-002779; DOE/CS-62018/T1) Avail: CASI HC A03/MF A01

The state of Kansas hosted the First International Alternative Fueled Vehicle Round-Up June 8-9, 1992. This event was conceived and initiated in the Alternative Fuels Program of the Energy Section of the Kansas Corporation Commission (KCC). The objective was to emphasize and publicize the need for and the current viability of alternative fuels to the general public, fleet operators, environmentalists, utility operators, government officials, school systems, transportation providers and others interested in moving toward the usage of cost effective clean-burning domestic fuels. When judging this original objective by the parameters of the participation of industry, media coverage, attendance at the event, satisfaction of the participants and exhibitors, feedback from the public and new activity generated by the high exposure, the Round-Up can be declared and outstanding success which exceeded the hopes and designs originally sought. DOE

N93-21699# Mechanical Technology, Inc., Latham, NY.

HIGH TEMPERATURE SUPERCONDUCTING BEARINGS FOR MECHANICAL COOLERS Monthly Report, 1-30 Oct. 1992

30 Oct. 1992 5 p

(Contract SDIO84-89-C-0043)

(AD-A259316) Avail: CASI HC A01/MF A01

Accomplishment during the reporting period is reported. The radial superconducting bearings were built. The uniqueness of this bearing is that the journal is made of rings of permanent magnets and irons. The permanent magnets energize the rings, so that high gradients are developed around the periphery where the flux impinges on the superconductor surface. The tests indicate this type of bearing improves stiffness by a factor of 2 over baseline arrangement that uses a solid piece of magnetic ring on journal. GRA

N93-21714# Electric Research and Management, Inc., State College, PA.

SAFETY OF HIGH SPEED MAGNETIC LEVITATION TRANSPORTATION SYSTEMS. MAGNETIC FIELD TESTING OF THE TR07 MAGLEV VEHICLE AND SYSTEM. VOLUME 2: APPENDICES Final Report, Jun. 1991 - Mar. 1992

Fred Dietrich, David Robertson, and George Steiner Apr. 1992 330 p

(Contract DTFR53-91-C-00047)

(PB92-224674; DOT/FRA/ORD-92/09.2-Vol-2;

DOT-VNTSC-FRA-92-6.2-Vol-2) Avail: CASI HC A15/MF A03

The safety of various magnetically levitated (maglev) and high speed rail (HSR) trains proposed for application in the United States is of direct concern to the Federal Railroad Administration (FRA). The characterization of electric and magnetic fields (EMF) emissions, both steady (dc) and produced by alternating current (ac) at power frequency (50 Hz in Europe and 60 Hz in the U.S.) and other frequencies in the Extreme Low Frequency (ELF) range (3-3000 Hz), and associated public and worker exposures to EMF, are a growing health and safety concern worldwide. As part of a comprehensive safety assessment of the German TransRapid (TR-07) maglev system undertaken by the FRA, with technical support from the DOT/RSPA Volpe National Transportation System Center (VNTSC), magnetic field measurements were performed by Electric Research and Management, Inc. (ERM) at the Transrapid Test Facility (TVE) in Emsland, Germany in August, 1990. Appendices include catalogs and documents detailing magnetic field data files and their specifics (static fields, spectral waveforms, and temporal and spatial information) by location. Author (revised)

N93-21715# Electric Research and Management, Inc., State College, PA.

SAFETY OF HIGH SPEED MAGNETIC LEVITATION TRANSPORTATION SYSTEMS. MAGNETIC FIELD TESTING OF THE TR07 MAGLEV VEHICLE AND SYSTEM. VOLUME 1: ANALYSIS Final Report, Jun. 1991 - Mar. 1992

Fred Dietrich and William E. Feero Apr. 1992 188 p

(Contract DTFR53-91-C-00047)

(PB92-224666; DOT/FRA/ORD-92/09.1-Vol-1;

DOT-VNTSC-FRA-92-6.1-Vol-1) Avail: CASI HC A09/MF A02

The safety of various magnetically levitated (maglev) and high speed rail (HSR) trains proposed for application in the United States is of direct concern to the Federal Railroad Administration (FRA). The characterization of electric and magnetic field (EMF) emissions, both steady (dc) and produced by alternating currents (ac) at power frequency (50 Hz in Europe and 60 Hz in the U.S.) and other frequencies in the Extreme Low Frequency (ELF) range (3-3000 Hz), and associated public and worker exposure to EMF, are a growing health and safety concern worldwide. As part of a comprehensive safety assessment of the German TransRapid (TR-07) maglev system undertaken by the FRA, with technical support from the DOT/RSPA Volpe National Transportation System Center (VNTSC), magnetic field measurements were performed by Electric Research and Management, Inc. (ERM) at the Transrapid Test Facility (TVE) in Emsland, Germany in August, 1990. Analysis summarizes the experimental findings and compares results to common home, work, and power lines emissions for selected spectral bands. Author (revised)

N93-21832# Florida Univ., Gainesville.

NON-NEWTONIAN TEMPERATURE AND PRESSURE EFFECTS OF A POWDER LUBRICANT SLURRY IN A ROTATING HYDROSTATIC STEP BEARING M.S. Thesis

William E. Finn 1993 56 p

(Contract N00123-89-G-0549)

(AD-A259325) Avail: CASI HC A04/MF A01

The pressure and temperature effects of graphite powder lubricant added to a carrier fluid of ethylene glycol as applied in a rotating hydrostatic step bearing were investigated. After the testing apparatus was designed and modified, the temperature and pressure profiles were determined analytically and experimentally. The rheological behavior of the non-Newtonian lubricant was modeled using a power law model developed previously. This model has been proven to match experimental data and was therefore the tool used for comparison with research data. Ethylene glycol was used as the Newtonian lubricant for the initial experimentation, which provided a check on the test apparatus and a comparison with the non-Newtonian graphite slurry. GRA

N93-21841# Sandia National Labs., Albuquerque, NM.
HYPERVELOCITY IMPACT TESTS AND SIMULATIONS OF SINGLE WHIPPLE BUMPER SHIELD CONCEPTS AT 10 km/s
L. C. Chhabildas, E. S. Hertel, and S. A. Hill (National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.) 1992 15 p Presented at the Hypervelocity Impact Symposium, Austin, TX, 17-20 Nov. 1992
(Contract DE-AC04-76DP-00789)
(DE93-003999; SAND-92-2355C; CONF-921162-14) Avail: CASI HC A03/MF A01

A series of experiments was performed to evaluate the effectiveness of a Whipple bumper shield to orbital space debris at impact velocities of approximately 10 km/s. Upon impact by a 19 mm (0.87 mm thick, L/D approximately 0.5) flier plate, the thin aluminum bumper shield disintegrates into a debris cloud. The debris cloud front propagates axially at velocities of approximately 14 km/s and expands radially at a velocity of approximately 7 km/s. Subsequent loading by the debris on a 3.2 mm thick aluminum substructure placed 114 mm from the bumper penetrates the substructure completely. However, when the diameter of the flier plate is reduced to 12.7 mm, the substructure, although damaged, is not perforated over the duration of the experiment. Numerical simulations performed using the multi-dimensional hydrodynamics code CTH also predict complete perforation of the substructure by the subsequent debris cloud for the larger flier plate. The numerical simulation for a 12.7 mm flier plate, however, shows a strong dependence on assumed impact geometry, i.e., a spherical projectile impact geometry does not result in perforation of the substructure by the subsequent debris cloud, while the flat plate impact geometry results in perforation. DOE

N93-21974# Argonne National Lab., IL.
THE NATURAL GAS VEHICLE CHALLENGE 1992: EXHAUST EMISSIONS TESTING AND RESULTS
W. A. Rimkus, R. P. Larsen, M. G. Zammit (Johnson Matthey Environmental Products, Wayne, PA.), J. G. Davies (General Motors of Canada Ltd., London, Ontario.), G. S. Salmon (General Motors of Canada Ltd., London, Ontario.), and R. I. Bruetsch (Environmental Protection Agency, Ann Arbor, MI.) 1992 22 p Presented at the International Fuels and Lubricants Meeting and Exposition, San Francisco, CA, 19-22 Oct. 1992
(Contract W-31-109-eng-38)
(DE93-002997; ANL/CP-77453; CONF-9210140-1) Avail: CASI HC A03/MF A01

The Natural Gas Vehicle (NGV) Challenge '92, was organized by Argonne National Laboratory. The main sponsors were the U.S. Department of Energy the Energy, Mines, and Resources -- Canada, and the Society of Automotive Engineers. It resulted in 20 varied approaches to the conversion of a gasoline-fueled, spark-ignited, internal combustion engine to dedicated natural gas use. Starting with a GMC Sierra 2500 pickup truck donated by General Motors, teams of college and university student engineers worked to optimize Chevrolet V-8 engines operating on natural gas for improved emissions, fuel economy, performance, and advanced design features. This paper focuses on the results of the emission event, and compares engine mechanical configurations, engine management systems, catalyst configurations and locations, and approaches to fuel control and the relationship of these parameters to engine-out and tailpipe emissions of regulated exhaust constituents. Nine of the student modified trucks passed the current levels of exhaust emission standards, and some exceeded the strictest future emissions standards envisioned by the U.S. Environmental Protection Agency. Factors contributing to good emissions control using natural gas are summarized, and observations concerning necessary components of a successful emissions control strategy are presented. DOE

N93-22007*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
ROBOT FRIENDLY PROBE AND SOCKET ASSEMBLY Patent Application
Karen L. Nyberg, inventor (to NASA) 14 Dec. 1992 14 p
(NASA-Case-MSC-22028-1; NAS 1.71:MSC-22028-1;
US-Patent-Appl-SN-993477) Avail: CASI HC A03/MF A01

A probe and socket assembly for serving as a mechanical interface between structures is presented. The assembly comprises a socket having a housing adapted for connection to a first supporting structure and a probe which is readily connectable to a second structure and is designed to be easily grappled and manipulated by a robotic device for insertion and coupling with the socket. Cooperable automatic locking means are provided on the probe shaft and socket housing for automatically locking the probe in the socket when the probe is inserted a predetermined distance. A second cooperable locking means on the probe shaft and housing are adapted for actuation after the probe has been inserted the predetermined distance. Actuation means mounted on the probe and responsive to the grip of the probe handle by a gripping device, such as a robot for conditioning the probe for insertion and are also responsive to release of the grip of the probe handle to actuate the second locking means to provide a hard lock of the probe in the socket. NASA

N93-20430# National Space Development Agency, Ibaraki (Japan). Thermal and Structural Engineering Lab.
RESEARCH ON HOPE ACTUATOR POWER UNIT [HOPE DOURYOKU SOUCHI NO KRNKYUU]
Haruaki Itagaki, Tooru Iida, and Yasuo Ishii *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 93-96 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20440# National Space Development Agency, Ibaraki (Japan). Launch Vehicle and Satellite System Lab.
RESEARCH ON SPACE ROBOT TECHNOLOGY [UCHUUYOU ROBOTTO GIJUTSU NO KENKYUU]
Tsutomu Iwata, Yasufumi Wakabayashi, and Mitsushige Oda *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 141-144 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

N93-20621# Institut de Recherche de l'Hydro-Ontario, Toronto.
THE ARK (AUTONOMOUS ROBOT FOR A KNOWN ENVIRONMENT) PROJECT
S. B. Nickerson, F. Camacho, D. L. Mader, E. E. Milios (Toronto Univ., Ontario.), M. R. M. Jenkin (York Univ., Downsview, Ontario.), N. Bains (Atomic Energy of Canada Ltd., Sheridan Park, Ontario.), P. Braun (Atomic Energy of Canada Ltd., Sheridan Park, Ontario.), D. Green (National Research Council of Canada, Ottawa, Ontario.), S. Hung (National Research Council of Canada, Ottawa, Ontario.), and L. Korba (National Research Council of Canada, Ottawa, Ontario.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 76-77 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20637# Boliden Allis Canada, Inc., Kirkland (Ontario).
PARALLEL AXES GEAR SET OPTIMIZATION IN TWO-PARAMETER SPACE
Y. Theberge, A. Cardou (Laval Univ., Quebec.), and L. Cloutier (Laval Univ., Quebec.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 174-175 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20662# Windsor Univ. (Ontario). Dept. of Mechanical Engineering.
RESONANT RESPONSE ANALYSIS OF A HIGH SPEED GEAR
Jean Lee *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 268-269 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20693# Alberta Univ., Edmonton. Dept. of Mechanical Engineering.
ON THE THERMOELASTOHYDRODYNAMIC LUBRICATION DIMENSIONLESS PROBLEM FORMULATIONS
C. M. Rodkiewicz and K. Hou (National Research Council of Canada, Victoria, British Columbia.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 602-603 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20696# Concordia Univ., Montreal (Quebec). Dept. of Mechanical Engineering.
STOCHASTIC FINITE ELEMENT ANALYSIS FOR HIGH SPEED ROTORS
T. S. Sankar, S. Anantha Ramu (Indian Inst. of Science, Bangalore.), and R. Ganesan *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 610-611 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20703# Technical Univ. of Istanbul (Turkey).
A RECENT BOUNDARY INTEGRAL PROCEDURE ON DETERMINING SHEAR CENTERS, WARPING CONSTANT AND OTHER CROSS SECTIONAL PROPERTIES OF A TURBINE BLADE
Vedat Karadag *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 638-639 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20704# Laval Univ. (Quebec). Dept. of Mechanical Engineering.
A BOUNDARY ELEMENT FORMULATION FOR THERMO-HYDRODYNAMIC LUBRICATION PROBLEM
A. Gakwaya and B. Imcaoudene *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 640-641 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20705# Laval Univ. (Quebec). Dept. of Mechanical Engineering.
BOUNDARY ELEMENT FORMULATION FOR THERMOELASTOHYDRODYNAMIC CONTACT PROBLEMS
A. Gakwaya and D. Despres *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 642-643 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20708# Victoria Univ. (British Columbia). Dept. of Mechanical Engineering.
MULTIPLE-ARM JOINT RATE SOLUTION BY BRANCH RESULT ASSEMBLY
Ron P. Podhorodeski *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 650-651 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20710# Memorial Univ. of Newfoundland, Saint Johns.
EFFICIENT AND ACCURATE ON-LINE COMPUTATION OF MOTOR TORQUES FOR ROBOTIC MANIPULATORS
A. M. Sharan and C. Dhanaraj *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 654-655 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20713# Carleton Univ., Ottawa (Ontario). Dept. of Systems and Computer Engineering.
NONLINEAR FRICTION EFFECTS ON PRECISE MOTION CONTROL OF A MANIPULATOR
G. D. Warshaw, A. Jnifene (Ottawa Univ., Ontario.), and D. Necsulescu (Ottawa Univ., Ontario.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 660-661 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20715# Wollongong Univ. (Australia). Dept. of Mechanical Engineering.
LOAD CARRYING CAPACITY FOR A TWO-LINK PLANAR FLEXIBLE ARM
M. Habibnejad Korayem, Y. Yao, and A. Basu *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 664-665 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20717# McGill Univ., Montreal (Quebec). Dept. of Mechanical Engineering.
STRUCTURAL SHAPE OPTIMIZATION OF ROBOTIC LINKS
J. Ghattas and J. Angeles *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 668-669 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20718# Laval Univ. (Quebec). Dept. of Mechanical Engineering.
POLYNOMIAL SOLUTION OF THE DIRECT GEOMETRIC PROBLEM OF A PARALLEL SPHERICAL MANIPULATOR [SOLUTION POLYNOMIALE AU PROBLEME GEOMETRIQUE DIRECT D'UN MANIPULATEUR PARALLELE SPHERIQUE]
Clement M. Gosselin and Jaouad Sefrioui *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 670-671 In FRENCH (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20720# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
GRASP ADMITTANCE CENTER. A CONCEPT
K. B. Shimoga and A. A. Goldenberg *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 674-675 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20721# British Columbia Univ., Vancouver. Dept. of Electrical Engineering.
ON IDENTIFICATION OF HYDRAULIC COMPLIANCE USING A GENETIC ALGORITHM
F. Wan, N. Sepehri, K. Kristinsson, G. A. M. Dumont, and P. D. Lawrence *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 678-679 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-21434*# Logicon Control Dynamics Co., Huntsville, AL.
A METHOD FOR MODELING CONTACT DYNAMICS FOR AUTOMATED CAPTURE MECHANISMS Abstract Only
Philip J. Williams *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 25-26 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21441*# Martin Marietta Corp., Denver, CO. Civil Space and Communications Div.
EXPERIMENTAL VALIDATION OF DOCKING AND CAPTURE USING SPACE ROBOTICS TESTBEDS Abstract Only
John Spofford *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 32 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N93-20373# Army Lab. Command, Watertown, MA. Material Technology Lab.
ACOUSTIC WAVE PROPAGATION IN AN ADHESIVE BOND MODEL WITH DEGRADING INTERFACIAL LAYERS Final Report
Robert F. Anastasi and Mark J. Roberts Sep. 1992 38 p
(AD-A258684; MTL-TR-92-63) Avail: CASI HC A03/MF A01

This report discusses analytical and numerical approaches for the theoretical analysis of adhesively bonded structures having various bondline quality levels. Since the adhesive strength of an adhesively bonded structure is the critical failure problem of a bond under small loads, the discussions in this paper concentrate on mathematical models which use interfacial layers between the adherend and adhesive layers as a means to show various degrees of bond quality. The analytical method discussed is a reflection coefficient calculation for multilayered structures in the frequency

domain. The numerical approach used is the finite element method yielding time domain results for adhesively bonded structures having various interfacial layer conditions. Direct comparisons between the two methods are accomplished in the frequency domain, the time domain results obtained via the finite element method being appropriately Fast Fourier Transformed (FFT). GRA

N93-20884# Technische Univ., Berlin (Germany). Fachbereich Physik.
ELECTRON OPTICAL DEFECT INSPECTION IN X RAY LITHOGRAPHY MASKS Ph.D. Thesis [ELEKTRONENOPTISCHE DEFEKTERKENNUNG IN ROENTGENLITHOGRAPHIEMASKEN]
Martin Boerner 1992 106 p In GERMAN Sponsored by BMFT
(ETN-93-92570) Avail: CASI HC A06/MF A02

The feasibility of electrooptical defect inspection in X-ray lithography masks with submicron design is examined. An Experimental Defect Inspection System (EDIS) was developed. This system is based on a commercial scanning electron microscope. The experimental and theoretical results were used for the definition of a commercial tool and for the inspection of future chip generation masks. A Monte Carlo simulation program was developed with which various electrooptical signals of any mask design can be calculated in a primary energy field from 10 to 2000 keV. The perspectives of further development and the multiple applications of the simulation program are shown. ESA

N93-20929# Construcciones Aeronauticas S.A., Madrid (Spain). Direccion Proyectos.
NONCONTACT NONDESTRUCTIVE TESTS [ENSAYOS NO DESTRUCTIVOS SIN CONTACTO]
M. Alvaro, F. J. Moreno, J. M. MartindeBernardo, and V. Cortes 1992 12 p In SPANISH Presented at the 7th Congresso Espanol y 1st Pirenaico de Ensayos No Destructivos
(ETN-93-93060) Avail: CASI HC A03/MF A01

Methods developed for noncontact nondestructive tests are reviewed. These tests were developed to improve the applicability of nondestructive tests, which were constrained to the use of sensors and contacts. The techniques applied involve ultrasonic waves for lasers, optical interferometry, thermography, and Compton effect x-ray analysis. The following topics are presented: holographic pattern, holographic reconstruction, source laser, technical holographic inspection methods, real time interferometry, pulsed laser holograms, application problems and result interpretation, thermal analysis principles and procedures, production of ultrasonic waves by lasers, and ultrasonic interferometric analysis. ESA

N93-21199# National Inst. of Standards and Technology, Gaithersburg, MD. Electronics and Electrical Engineering Lab.
DETECTION OF INCIPIENT DEFECTS IN CABLES BY PARTIAL DISCHARGE SIGNAL ANALYSIS
F. D. Martzloff, E. Simmon, J. P. Steiner, and R. J. VanBrunt Jul. 1992 145 p
(Contract NRC-RES-91-001)
(PB92-222744; NISTIR-4487) Avail: CASI HC A07/MF A02

As one of the objectives of a program aimed at assessing test methods for in-situ detection of incipient defects in cables due to aging, a laboratory test system was implemented to demonstrate that the partial discharge analysis method can be successfully applied to low-voltage cables. Previous investigations generally involved cables rated 5 kV or higher, while the objective of the program focused on the lower voltages associated with the safety systems of nuclear power plants. The defect detection system implemented for the project was based on commercially available signal analysis hardware and software packages, customized for the specific purposes of the project. The test specimens included several cables of the type found in nuclear power plants, including artificial defects introduced at various points of the cable. The results indicate that indeed, partial discharge analysis is capable of detecting incipient defects in low-voltage cables. There are, however, some limitations of technical and non-technical nature that need further exploration before this method can be accepted in the industry. GRA

N93-21822# Smith (Wilbur) and Associates, Washington, DC.
A LITERATURE REVIEW OF TIME-DETERIORATION PREDICTION TECHNIQUES
Ronald L. Purvis, Donald R. Graber, Kenneth C. Clear (Clear, Kenneth C., Inc., Sterling, VA.), and Michael J. Markow (Cambridge Systematics, Inc., MA.) Jul. 1992 147 p Sponsored by NAS-NRC
(PB92-229202; SHRP-C/UFR-92-613) Avail: CASI HC A07/MF A02

A literature review of existing deterioration models used to predict corrosion-related deterioration on reinforced concrete bridges is presented. Most models in this review are based on the performance of all bridges in a system. In addition, the model information was developed using condition ratings provided by technical-inspectors performing visual surveys in accordance with the National Bridge Inspection Standards (NBIS). Discussion of the models illuminates equation definitions, research parameters, and life-cycle cost analyses. An annotated bibliography is included.
GRA (revised)

N93-21956# Argonne National Lab., IL.
USE OF VOLUME X RAY TOMOGRAPHY FOR CHARACTERIZING DENSITY VARIATIONS IN AS-CAST CERAMIC BODIES
W. A. Ellingson, D. L. Holloway, E. A. Sivers, J. Ling (Academia Sinica, Shanghai, China.), J. P. Pollinger (Allied-Signal Aerospace Co., Torrance, CA.), and H. C. Yeh (Allied-Signal Aerospace Co., Torrance, CA.) 1992 10 p Presented at the Winter Annual Meeting of the American Society of Mechanical Engineers (ASME), Anaheim, CA, 8-13 Nov. 1992
(Contract W-31-109-eng-38)
(DE93-002906; ANL/MCT/CP-77573; CONF-921110-32) Avail: CASI HC A02/MF A01

A joint project is ongoing to evaluate nondestructive characterization (NDC) methods to detect and measure process-induced variations in ceramic materials. The process methods of current focus are slip-casting and injection molding, and a primary NDC method being evaluated is microfocus X-ray computed tomography (XCT). SiC-whisker-reinforced Si3N4 was pressure-slip-cast under the following conditions: at two casting pressures, 0.103 and 0.276 MPa (15 and 40 psi); and at length/diameter ratios of 1.5, and 2.67 with whisker contents of 20, 23, 27, and 30 wt. percent. Three-dimensional microfocus XCT was used to study density variations in billets produced by different process conditions. Destructive measurement of density variation has been compared to the XCT measurements and correlations have been established. XCT has been proven (by destructive verification) to be capable of detecting less than 5 percent variations in as-cast density. DOE

N93-21982# Argonne National Lab., IL.
AN ACOUSTO-ULTRASONIC NDE TECHNIQUE FOR MONITORING MATERIAL ANISOTROPY
Hual Te Chien, Shuh Haw Sheen, and A. C. Raptis Aug. 1992 14 p Presented at the Quantitative Nondestructive Evaluation Conference, San Diego, CA, 19-24 Jul. 1992
(Contract W-31-109-eng-38)
(DE93-002994; ANL/CP-75819; CONF-9207155-2) Avail: CASI HC A03/MF A01

A simpler and better way of monitoring the anisotropy of fiber-reinforced composite materials, based on the acousto-ultrasonic (AU) approach, is presented. In this approach, time of flight (TOF) of the AU waves, rather than the stress wave factor, is measured. Two fundamental Lamb modes are generated under the first critical frequency: one is the first antisymmetric mode traveling with a slower velocity while the other is the first symmetric mode traveling with a faster speed. The later one is sensitive to the azimuthal angle and nearly nondispersive, and has a phase velocity very close to that of the bulk longitudinal wave of the material. Experimental data measured from two methods, TOF measurement and slope method, are compared with theoretical results; a good agreement is obtained for monitoring the material anisotropy. There is a great potential for this AU approach in material-property evaluation and in quantitative measurements of defects and debonding of fiber-reinforced composites. However, more studies are needed to better understand the effect of the fiber/matrix bonding on the measurements and to extract more information from the AU signals. DOE

N93-20837# Rafael Armament Development Authority, Haifa (Israel).
QUALITY ASSURANCE IN THE FUTURE INDUSTRIAL PLANT
Avner Halevy *In* CASA-RI/SME, Proceedings of the International Conference on CAD/CAM and AMT. Volume 2: CIRP Sessions on Tolerancing, for Function in a CAD/CAM Environment 14 Dec. 1989

2 p (For primary document see N93-20823 07-61)
(Paper-C-3-3) Avail: CASI HC A01/MF A02

N93-20839# Rafael Armament Development Authority, Haifa (Israel).
TOTAL QUALITY ASSURANCE
E. Louzon *In* CASA-RI/SME, Proceedings of the International Conference on CAD/CAM and AMT. Volume 2: CIRP Sessions on Tolerancing, for Function in a CAD/CAM Environment 14 Dec. 1989 3 p (For primary document see N93-20823 07-61)
(Paper-C-3-5) Avail: CASI HC A01/MF A02

N93-21528# Brussels Univ. (Belgium). Composite Systems and Adhesion Research Group.
DEFECT ANALYSIS USING ADVANCED INTERPRETATION OF THE REFLECTED WAVE DURING ULTRASONIC SCANNING
L. Schillemans, D. VanHemelrijck, F. DeRoey, W. P. DeWilde, A. H. Cardon, and A. A. Anastassopoulos *In* AGARD, Debonding/Delamination of Composites Dec. 1992 17 p Sponsored by Belgian National Foundation for Scientific Research Prepared in cooperation with Patras Univ., Greece (For primary document see N93-21507 07-24)
Copyright Avail: CASI HC A03/MF A03

N93-21529# Hellenic Aerospace Industry, Schimatari (Greece). Advanced Materials, Processes and Manufacturing Lab.
DAMAGE DETECTION BY ACOUSTO-ULTRASONIC LOCATION (AUL)
Z. P. Marioli-Riga, A. N. Karanika, T. P. Philippidis (Patras Univ., Greece.), and S. A. Paipetis (Patras Univ., Greece.) *In* AGARD, Debonding/Delamination of Composites Dec. 1992 3 p (For primary document see N93-21507 07-24)
Copyright Avail: CASI HC A01/MF A03

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N93-19971*# Sverdrup Technology, Inc., Brook Park, OH. Research Center Group.
MULTIDISCIPLINARY TAILORING OF HOT COMPOSITE STRUCTURES
Surendra N. Singhal and Christos C. Chamis (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.) Cleveland, OH Feb. 1993 20 p Proposed for presentation at the 33rd Structures, Structural Dynamics and Materials Conference, Dallas, TX, 13-15 Apr. 1993; cosponsored by the AIAA, ASME, ASCE, AHS, and ASC Previously announced in IAA as A92-34564
(RTOP 505-62-53)
(NASA-TM-106027; E-7589; NAS 1.15:106027) Avail: CASI HC A03/MF A01

A computational simulation procedure is described for multidisciplinary analysis and tailoring of layered multi-material hot composite engine structural components subjected to simultaneous multiple discipline-specific thermal, structural, vibration, and acoustic loads. The effect of aggressive environments is also simulated. The simulation is based on a three-dimensional finite element analysis technique in conjunction with structural mechanics codes, thermal/acoustic analysis methods, and tailoring procedures. The integrated multidisciplinary simulation procedure is general-purpose including the coupled effects of nonlinearities in structure geometry, material, loading, and environmental complexities. The composite material behavior is assessed at all composite scales, i.e., laminate/ply/constituents (fiber/matrix), via a nonlinear material characterization hygro-thermo-mechanical model. Sample tailoring cases exhibiting nonlinear material/loading/environmental behavior of aircraft engine fan blades, are presented. The various multidisciplinary loads lead to different tailored designs, even those competing with each other, as in the case of minimum material cost versus minimum structure weight and in the case of minimum vibration frequency versus minimum acoustic noise. Author

N93-19972*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL. Structures and Dynamics Lab.
THE ANALYTICAL REPRESENTATION OF VISCOELASTIC MATERIAL PROPERTIES USING OPTIMIZATION TECHNIQUES
S. A. Hill Feb. 1993 23 p
(NASA-TM-108394; NAS 1.15:108394) Avail: CASI HC A03/MF A01

This report presents a technique to model viscoelastic material properties with a function of the form of the Prony series. Generally, the method employed to determine the function constants requires assuming values for the exponential constants of the function and then resolving the remaining constants through linear least-squares techniques. The technique presented here allows all the constants to be analytically determined through optimization techniques. This technique is employed in a computer program named PRONY and makes use of commercially available optimization tool developed by VMA Engineering, Inc. The PRONY program was utilized to compare the technique against previously determined models for solid rocket motor TP-H1148 propellant and V747-75 Viton fluoroelastomer. In both cases, the optimization technique generated functions that modeled the test data with at least an order of magnitude better correlation. This technique has demonstrated the capability to use small or large data sets and to use data sets that have uniformly or nonuniformly spaced data pairs. The reduction of experimental data to accurate mathematical models is a vital part of most scientific and engineering research. This technique of regression through optimization can be applied to other mathematical models that are difficult to fit to experimental data through traditional regression techniques. Author

N93-19992*# General Electric Co., Cincinnati, OH. Advanced Technology Operation.
ELEVATED TEMPERATURE CRACK GROWTH Final Report, Aug. 1988 - Jun. 1992
K. S. Kim and R. H. VanStone Dec. 1992 117 p
(Contract NAS3-23940)
(NASA-CR-189191; NAS 1.26:189191; R89AEB325-01) Avail: CASI HC A06/MF A02

The purpose of this program was to extend the work performed in the base program (CR 182247) into the regime of time-dependent crack growth under isothermal and thermal mechanical fatigue (TMF) loading, where creep deformation also influences the crack growth behavior. The investigation was performed in a two-year, six-task, combined experimental and analytical program. The path-independent integrals for application to time-dependent crack growth were critically reviewed. The crack growth was simulated using a finite element method. The path-independent integrals were computed from the results of finite-element analyses. The ability of these integrals to correlate experimental crack growth data were evaluated under various loading and temperature conditions. The results indicate that some of these integrals are viable parameters for crack growth prediction at elevated temperatures. Author

N93-20034*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
IMPROVEMENTS TO A METHOD FOR THE GEOMETRICALLY NONLINEAR ANALYSIS OF COMPRESSIVELY LOADED STIFFENED COMPOSITE PANELS Progress Report, Jul. - Dec. 1991
Dec. 1991 17 p
(Grant NAG1-1215)
(NASA-CR-192183; NAS 1.26:192183) Avail: CASI HC A03/MF A01

This report describes progress made during the period July 1991 to December 1991 on the tasks identified in the technical proposals for the subject grant. The plans for further effort on each of the tasks are outlined. The computer implementation of the method of analysis under development is referred to in this document as NLPAN. These tasks included: (1) implementation of continuation methods; (2) dynamic analysis capability; (3) additional boundary condition options for the panel ends; (4) transverse pressure loading; (5) second-order displacement fields; and (6) results for an i-stiffened panel with a complex cross section. Derived from text

N93-20060# Ecole Centrale de Lyon (France).
CYCLIC BEHAVIOR MODELLING Ph.D. Thesis [MODELISATION DU COMPORTEMENT CYCLIQUE DES ARGILES]
Philippe Dubujet 1992 169 p In FRENCH
(ECL-92-09; ETN-93-93052) Avail: CASI HC A08/MF A02

An extension of a basic model, initially made for sand modeling is developed with the object of using it for clays. The formal principles of elastoplasticity as well as the origin of plasticity surface forms that are commonly used for soils are reviewed. This basic model was applied to study the behavior of clay by cyclic torsion experiments. The results show that it is not possible to reproduce dilatancy appearance in undrained cyclic experiments if the clay is normally consolidated. An analysis on how to introduce a Cam-Clay type closed surface into the basic model is given. The consolidation mechanisms as well as the deviatoric mechanisms of the proposed model extension are described. The identification process of the parameters for the proposed model is summarized. An analytical process of identification from drained and undrained experiments is given. The analysis of the simulation results conducted is included. ESA

N93-20118* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

METHOD AND APPARATUS FOR DETERMINATION OF MATERIAL RESIDUAL STRESS Patent

Engmin J. Chern, inventor (to NASA) and Yury Flom, inventor (to NASA) 16 Mar. 1993 6 p Filed 2 Dec. 1991 Supersedes N92-23549 (30 - 14, p 2388)

(NASA-Case-GSC-13451-1; US-Patent-5,193,395; US-Patent-Appl-SN-801141; US-Patent-Class-73-779; US-Patent-Class-73-797; US-Patent-Class-324-222; Int-Patent-Class-G01N-3/32) Avail: US Patent and Trademark Office

A device for the determination of residual stress in a material sample consisting of a sensor coil, adjacent to the material sample, whose resistance varies according to the amount of stress within the material sample, a mechanical push-pull machine for imparting a gradually increasing compressional and tensional force on the material sample, and an impedance gain/phase analyzer and personal computer (PC) for sending an input signal to and receiving an input signal from the sensor coil is presented. The PC will measure and record the change in resistance of the sensor coil and the corresponding amount of strain of the sample. The PC will then determine, from the measurements of change of resistance and corresponding strain of the sample, the point at which the resistance of the sensor coil is at a minimum and the corresponding value and type of strain of the sample at that minimum resistance point, thereby, enabling a calculation of the residual stress in the sample.

Official Gazette of the U.S. Patent and Trademark Office

N93-20232*# Akron Univ., OH.

HIERARCHICAL POLY TREE CONFIGURATIONS FOR THE SOLUTION OF DYNAMICALLY REFINED FINTE ELEMENT MODELS

G. D. Gute and J. Padovan Jan. 1993 114 p

(Grant NAG3-664; RTOP 505-63-53)

(NASA-CR-191054; E-7532; NAS 1.26:191054) Avail: CASI HC A06/MF A02

This paper demonstrates how a multilevel substructuring technique, called the Hierarchical Poly Tree (HPT), can be used to integrate a localized mesh refinement into the original finite element model more efficiently. The optimal HPT configurations for solving isoparametrically square h-, p-, and hp-extensions on single and multiprocessor computers is derived. In addition, the reduced number of stiffness matrix elements that must be stored when employing this type of solution strategy is quantified. Moreover, the HPT inherently provides localize 'error-trapping' and a logical, efficient means with which to isolate physically anomalous and analytically singular behavior. Author (revised)

N93-20271# California Univ., Santa Barbara. Dept. of Materials.

EFFECT OF MICROSTRUCTURE ON THE STRENGTH AND FRACTURE ENERGY OF BIMATERIAL INTERFACES Annual Report, 1 Jan. 1990 - 31 Dec. 1992

Anthony G. Evans 31 Dec. 1992 360 p

(Contract N00014-90-J-1300)

(AD-A259181) Avail: CASI HC A16/MF A03

The annual report of the Office of Naval Research grant at UCSB on the Strength and Fracture Energy of Bimaterial Interfaces includes three sections: Mechanics of Interfaces, Coating Design for Composite Systems, and Mechanics of Brittle Matrix Composites. For more details see the Executive Summary. GRA

N93-20325# Army Engineer Waterways Experiment Station, Vicksburg, MS. Geotechnical Lab.

TWO-DIMENSIONAL PLANAR GEOSYSTEMS SUBJECTED TO THREE-DIMENSIONAL DYNAMIC LOADS Final Report

David W. Sykora and Jose M. Roesset Sep. 1992 197 p

(AD-A258723; WES/TR/GL-92-16) Avail: CASI HC A09/MF A03

This report summarizes an analysis for estimating the variation of displacements in space and time produced by dynamic loads in complex isotropic media using a numerical approximation method. The important distinction is that the formulation allows certain three-dimensional (3-D) problems to be solved using a two-dimensional (2-D) numerical model. To implement this method, the stratigraphy and material properties cannot vary in a horizontal direction (2-D stratigraphy). However, the distribution and extent of loads may vary in both horizontal directions (3-D load) providing for the analysis of synthetic sources. These types of problems cannot be solved analytically but normally would be solved using a laborious 3-D numerical approximation. The procedure involves condensing the 3-D dynamic stiffness matrices into equivalent 2-D matrices and representing the load function in the out-of-plane direction with a Fourier expansion. This report summarizes previous studies of wave propagation, the proposed formulation and computer implementation of a new finite element computer code, and the validation and parametric analysis of this code. GRA

N93-20330# Technical Research Centre of Finland, Espoo. Metals Lab.

FATIGUE DESIGN 1992, VOLUME 2

Jussi Solin, ed., Gary Marquis, ed., Aslak Siljander, ed., and Sisko Sipilae, ed. 1992 379 p Symposium held in Helsinki, Finland, 19-22 May 1992; co-sponsored by European Structural Integrity Society, and Technology Development Center of Finland

(VTT-Symposium-131-Vol-2; ISBN-951-38-4082-4; ETN-93-93077)

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The prevention of fatigue failure of engineering structures and machine components subjected to cyclic loading is discussed. The fields of fatigue design, analysis, and testing are discussed through reviews, research reports, and illustrative case studies. The following topics are discussed: service loading, welded structures, surface improvement methods, optimization and numerical analysis (F/BEM (Finite/Boundary Element Method)), multiaxial fatigue, probabilistic approaches, component testing and analysis, case studies, and good design practice. Special emphasis is given to multiaxial fatigue, probabilistic aspects, and good design practice. For individual titles, see N93-20331 through N93-20357.

N93-20331# Illinois Univ., Urbana-Champaign. Dept. of Mechanical Engineering.

DISCRIMINATING EXPERIMENTS FOR MULTIAXIAL FATIGUE DAMAGE MODELS

Darrell Socie *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 2 1992 p 9-20 (For primary document see N93-20330 07-39)

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Multiaxial fatigue damage models and the experiments that are needed to discriminate between the models and determine the material constants are reviewed. Fatigue damage models can be based on stress, strain, or combinations of stress and strain. Only those models capable of assessing fatigue damage for variable amplitude nonproportional loading histories commonly found in structures are included. It is concluded that it is impossible to conduct enough experiments to validate any damage model for all loading situations. ESA

N93-20332# City Univ., London (England).

MULTIAXIAL FATIGUE LIFE PREDICTION USING A SHEAR STRESS BASED CRITICAL PLANE FAILURE CRITERION

Donald L. McDiarmid *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 2 1992 p 21-33 (For primary document see N93-20330 07-39)

Copyright Avail: CASI HC A03/MF A03

A shear stress based critical plane criterion of failure, modified for the effect of normal stress in the plane of maximum range of shear stress, was used to predict fatigue lives of thin wall tubular specimens subjected to biaxial in phase and 90 deg out of phase tension torsion loading. The criterion is found to correlate the experimental data with predictions being

within a factor of 2. Of the 42 experimental cases, 70 percent are predicted within a factor of 1.5. ESA

N93-20333# Riga Polytechnical Inst. (USSR). Inst. of Polymer Mechanics.

EFFECT OF PHASE LAG ON CYCLIC DURABILITY OF LAMINATED COMPOSITE

Janis Andersons, V. Limonov, and Vitants Tamuzs *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 2 1992 p 35-44 (For primary document see N93-20330 07-39)

Copyright Avail: CASI HC A02/MF A03

Theoretical and experimental results on fatigue of laminated fiber reinforced composites under out-of-phase, biaxial cyclic loading are presented. Experiments were carried out on tubular filament wound samples of epoxy matrix/organic (Kevlar type) fiber composites. Fatigue strength under two different loading modes, namely cyclic torsion combined with axial tension or compression, was investigated for phase lags psi = 0, pi/2, and pi. Durability was shown to decrease with increasing phase shift both for axial tension (R = 0.1) and compression (R = 10). A matrix failure criterion was proposed for a unidirectionally reinforced ply, and the ply discount method was modified to account for phase lag. Calculated S-N curves agree reasonably well with experimental data. ESA

N93-20334# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Structure Dept.

AN ENGINEERING TOOL FOR SOLVING MULTIAXIAL FATIGUE PROBLEMS

Madeleine Chaudonneret *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 2 1992 p 45-58 (For primary document see N93-20330 07-39)

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A lifing method based on a fatigue damage model, which itself is based on the concept of effective stress, is proposed. The uniaxial model was successfully tested on a wide range of materials and loadings, and it was recently extended to take into account proportional or non-proportional multiaxial loadings. Combined with a Neuber's method, it was used to predict crack initiation under stress concentration. It is a true engineering tool which can simply and effectively replace Miner's rule. ESA

N93-20335# Ecole Nationale Superieure d'Arts et Metiers, Talence (France). Lab. Materiaux Endommagement Fiabilite.

DESIGN AGAINST HIGH CYCLE MULTIAXIAL FATIGUE

Andre Galtier and Jacques Seguret *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 2 1992 p 59-74 (For primary document see N93-20330 07-39)

Copyright Avail: CASI HC A03/MF A03

A general procedure for multiaxial criteria for high numbers of cycles is described. This procedure is to be used at the research and development level. In this approach the various 'influence coefficients,' which have been quantified, are taken into account. Similarly, the 'condition coefficients' are introduced to complement the external forces model. When the usual criteria are applied to tests described in the literature, deviations between prediction and test results were observed. Introducing the triaxiality degree, a formulation which is closer to real the world, could be proposed. ESA

N93-20336# Academy of Sciences (USSR), Kazan. Physical-Technical Inst.

THE PREDICTING CRACK GROWTH FOR MIXED MODE FRACTURE UNDER BIAXIAL LOADS

Valery Shlyannikov *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 2 1992 p 75-86 (For primary document see N93-20330 07-39)

Copyright Avail: CASI HC A03/MF A03

A model for prediction crack growth rate and fatigue life under a biaxial load of arbitrary direction is suggested. The model takes into consideration the following: the change in material plastic properties in the region around the crack tip--due to the stress state, the initial orientation of the crack, and the trajectory of growth. The dependence of the determining characteristics upon the parameters of the material structure and the possibility of taking into account of the overload influence on crack growth rate and fatigue life for mixed mode fracture are shown. ESA

N93-20337# Slovak Academy of Sciences, Bratislava (Czechoslovakia). Inst. of Material and Machine Mechanics.

PREDICTION OF THE RANDOM LOAD FATIGUE LIFE DISTRIBUTION

Vladimir Kliman *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 2 1992 p 87-104 (For primary document see N93-20330 07-39)

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A method that enables a probabilistic approach to fatigue life estimation under random loading is presented. On the basis of a suitable segmentation of a sufficiently long random load process record and probabilistic interpretation of material characteristics expressed by their confidence intervals, a set of life data is obtained which allows the computation of a fatigue life Distribution Function (DF). The calculation method uses the energy fatigue damage accumulation hypothesis, rainflow method, and the mean stress effect expressed by means of the energy criterion. This DF respects the random character of the interacting material, and loading parameters can determine the resultant life for the required probability of failure occurrence or premature fracture. The method also allows assessing of the fatigue life under nonstationary random loading. The DF obtained is in a good agreement with the experimental results. ESA

N93-20338# Aalborg Univ. (Denmark). Dept. of Building Technology and Structural Engineering.

PROBABILISTIC CHAIN FATIGUE MODEL

Lise Gansted *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 2 1992 p 105-120 (For primary document see N93-20330 07-39)

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A new simple numerical fatigue crack growth model incorporating the physical knowledge of fatigue is established. The model, which is named the Fracture Mechanical Markov Chain Fatigue Model (FMF model), is based on the assumption that the crack propagation process can be described by a discrete space Markov theory. The method applies deterministic as well as random loads. The damage, which is measured as a crack length a, is assumed to progress in steps of the length delta(a). The damage process is described in a fracture mechanical point of view using the stress intensity factor K and Paris' equations. Determination of the model parameter delta(a) is based on experimental fatigue data for the given material. It turns out from comparison of simulated data and empirical data that both qualitative and quantitative demands are reasonably satisfied, and that the delta(a) can be regarded as a characteristic value of the material. Since all model parameters can be assumed constant for a given material, simulations of fatigue data, and thus estimation of lifetime, can easily be performed for any structural geometry knowing the geometry function. ESA

N93-20339# Politecnico di Milano (Italy). Dipt. di Meccanica.

AN EXPERIMENTAL APPROACH TO SIZE EFFECT IN ROTATING BENDING FATIGUE

Stefano Beretta, Paolo Clerici, and Giorgio Paolini *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 2 1992 p 121-135 Sponsored in part by Italian Ministry of Public Education (For primary document see N93-20330 07-39)

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The size effect in rotating bending fatigue was studied from a probabilistic point of view, comparing tests performed in annealed carbon steel specimens with different lengths and the same diameter. Experimental results show that long specimens have a spread of log-life over the entire S-N curve larger than short specimens data. Long specimens have a lower mean log-life at the highest stress levels, even if the difference is not statistically significant. No difference is observed in the lower branch of S-N curves and in the fatigue limits. The analysis shows that the experimental data of short specimens are not in accordance with a series system of two independent short specimens, described by a Weibull model. ESA

N93-20340# Toyota Coll. of Technology (Japan).

A SIMULATION OF CORROSION FATIGUE LIFE DISTRIBUTION IN LOW ALLOY STEEL

Masaki Nakajima, Hisashi Kunieda (Toyota Motor Co., Tokyo, Japan.), and Keiro Tokaji (Gifu Univ., Japan.) *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 2 1992 p 137-151 (For

primary document see N93-20330 07-39)
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A Monte Carlo simulation of corrosion fatigue life distributions was conducted in a low alloy steel, SNCM439, by assuming that the scatter of fatigue life resulted from the variation in the growth characteristics of corrosion pits and fatigue cracks. The parameters used in the simulation were obtained experimentally. The results showed that the experimental distributions were expressed satisfactorily by the simulation in which the parameters obtained from fatigue tests at the same stress were used. Therefore, it is concluded that corrosion fatigue life distribution can be predicted by a Monte Carlo simulation taking account of the statistical properties in the growth processes of corrosion pits and fatigue cracks.
ESA

N93-20341# Academy of Sciences (USSR), Moscow. Inst. of Mechanical Engineering Research.
PROBABILISTIC ASSESSMENT OF MACHINE PARTS FROM KYMENITE, AUSTEMPERED DUCTILE IRON
I. Petrova, M. Galperin, M. Alimov, and K. Jokipii (JOT-Companies Ltd., Helsinki, Finland.) *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 2 1992 p 153-166 (For primary document see N93-20330 07-39)
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The fatigue properties of Kymenite, austempered ductile iron, were investigated on the basis of the statistical theory of fatigue failure similarity. The fatigue tests were carried out on plain and notched specimens. The S-N curves for a given failure probability and the dependencies of similarity equation parameters on the number of cycles were obtained. These data allow to take into consideration the influence of design factors in the fatigue strength.
ESA

N93-20342# Technical Univ. of Lodz, Bielsko-Biala (Poland).
A SIMULATION METHOD OF DETERMINATION OF CONSTRUCTION PARTS FATIGUE LIFE DISTRIBUTION
Stanislaw Zawislak *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 2 1992 p 167-180 (For primary document see N93-20330 07-39)
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Constant fatigue damage lines hypothesis computer simulation was applied to determine the fatigue life distribution of bicycle parts. Values of quantities (Woehler curve coefficients, fatigue limit) were generated in accordance with their experimental determined distributions. Investigations were carried out for round, notch specimens, bicyle forks, and frames. Programmed and pseudorandom loading were applied in experiments and in calculations. Fatigue life distributions and fatigue life curves were determined in both cases. The compatibility of test and computation results of fatigue life distributions, fatigue life curves were verified. Application of the method could decrease the number of fatigue tests and enable proper comparison of fatigue life distribution for components. Both are advantageous in design practice.
ESA

N93-20343# VME Articulated Haulers A.B., Vaexjoe (Sweden).
STATISTICAL ANALYSIS OF FATIGUE TESTS
Karl Erik Olsson *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 2 1992 p 181-194 (For primary document see N93-20330 07-39)
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The ultimate aim of fatigue design, the minimization of the life cycle cost of the product, is discussed. The key is the load-strength model. Load and strength are described by distribution functions. Here the strength distribution is dealt with. Because of the 'weakest link theory' the three parameter Weibull distribution is the proper choice. With test results from a current project, the power of the Weibull analysis is demonstrated and some comments made about the traditional 'standard deviation of log cycles' approach. A Weibull transformation of rare occurrence, with the capability of separating different failure modes, is presented. Low stress level spectrum test results influenced by the 'fatigue limit' are easily separated. The difference between constant and variable amplitude test results is negligible. In the plane of the two Weibull parameters, shape and standardized location, it is possible to give a general view of component strength variation, from roller bearing life and fatigue stength of welds to yield strength.
ESA

N93-20344# Cambridge Univ. (England). Dept. of Materials Science and Metallurgy.
DISCRETE STATISTICAL MODEL OF FATIGUE CRACK GROWTH IN A NI-BASE SUPERALLOY, CAPABLE OF LIFE PREDICTION
Ashley Boyd-Lee and Julia King *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 2 1992 p 195-209 (For primary document see N93-20330 07-39)
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A discrete statistical model of fatigue crack growth in a nickel base superalloy Waspaloy, which is quantitative from the start of the short crack regime to failure, is presented. Instantaneous crack growth rate distributions and persistence of arrest distributions are used to compute fatigue lives and worst case scenarios without extrapolation. The basis of the model is non-material specific, it provides an improved method of analyzing crack growth rate data. For Waspaloy, the model shows the importance of good bulk fatigue crack growth resistance to resist early short fatigue crack growth and the importance of maximizing crack arrest both by the presence of a proportion of small grains and by maximizing grain boundary corrugation.
ESA

N93-20345# Bologna Univ. (Italy). Dipt. di Ingegneria delle Costruzioni Meccaniche, Nucleari, Aeronautiche e di Metallurgia.
TESTING RIG FOR LOW CYCLE FATIGUE TESTS IN COMBINED BENDING AND TORSION
Gianni Caligiana and Sergio Curioni *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 2 1992 p 211-226 (For primary document see N93-20330 07-39)
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In order to simulate, on samples, the fatigue behavior of notched or grooved shafts used in industrial plants, a biaxal testing equipment, to transform the alternate motion of a conventional testing machine into combined torsion and bending cyclic loadings, was devised and realized. Several different amplitude ratios between torsion and bending can be obtained beyond pure torsion and pure bending. Design choices, modeling, numerical simulations and experimental verifications performed for the testing apparatus are reported. Influence of misalignment and manufacturing imperfections on the behavior of the equipment are considered.
ESA

N93-20346# Nihon Univ., Funabashi (Japan).
FATIGUE EXPERIMENTS OF MICROCONCRETE BEAMS UNDER A RUNNING LOAD
Masahiro Kawaguchi, Yoshiaki Yaginuma, and Victor R. Macam, Jr. (Technological Univ. of the Philippines, Manila.) *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 2 1992 p 227-238 (For primary document see N93-20330 07-39)
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Singly reinforced microconcrete beams without shear reinforcement were tested under a static load, a fixed point repeated load and a running load. The beams had constant cross sections and had four variations of span lengths from 40 cm to 100 cm. The microconcrete had a maximum aggregate size of 2.5 mm and the steel ratio was 1.8 percent. A significant reduction in the fatigue life of the beams under a running load was observed. For a given magnitude of load, the fatigue life was reduced to about 1/10,000 of that under a fixed point repeated load. A running load subjects the beam to a larger stress range and seemed to give it a more serious damage than that of a fixed point repeated load. This reduction in fatigue life should be considered in the fatigue design of reinforced concrete bridge beams.
ESA

N93-20347# Politecnico di Milano (Italy). Dipt. di Meccanica.
MIXED MODE FATIGUE CRACK PROPAGATION IN A CRANKSHAFT
Mario Guagliano and L. Vergani *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 2 1992 p 239-255 (For primary document see N93-20330 07-39)
(Grant CT-91-03068-CT07)
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Experimental fatigue tests were carried out on a mechanical element and crack propagations influenced by all three fracture modes were observed. Numerical finite element models were realized considering two different crack extensions. Several calculations were conducted in order to determine the J Integral, by means of energetic considerations and the stress intensity

factors K1, K2, and K3 separately, by means of the stresses numerically obtained. An effective stress intensity was also determined, utilizing the Tanaka definition. ESA

N93-20348# Ceskoslovenska Akademie Ved, Prague. Aeronautical Research and Test Inst.

PROBABILISTIC ASPECTS OF GROWTH OF THE FATIGUE CRACKS IN THE RAILROAD AXLES

Petr Burian *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 2 1992 p 257-266 (For primary document see N93-20330 07-39)

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The method of determination of fatigue crack growth characteristics in diesel locomotives axles is described. These characteristics allow the user of these locomotives to determine how deep fatigue cracks will be in the critical place of the axle after a prescribed time of axle operation and for a prescribed level of hazard. This level of hazard, for instance 5 percent, means that the obtained conclusion will be invalid for 5 percent of the axles at maximum. The results were obtained from real operational cracks data by unsual mathematical methods for the separation of useful information, from information noise. ESA

N93-20349# Technical Univ. of Norway, Trondheim. Production Engineering.

FATIGUE PERFORMANCE OF NINE BOLT MATERIALS IN AIR AND IN SEA WATER WITH CATHODIC PROTECTION

Tor Slind, Tor Gunnar Eggen, Einar Bardal, and Per Jahn Haagensen (Norges Tekniske Vitenskapsakademi, Trondheim.) *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 2 1992 p 267-281 (For primary document see N93-20330 07-39)

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The hydrogen sensitivity of various bolt materials for subsea use was determined. The fatigue crack growth rates of eight materials were found in air and in artificial sea water 3 percent NaCl solution with Cathodic Protection (CP). SN tests of threaded bolts using a high mean stress were carried out in sea water with CP for two materials. The materials are grouped in three classes on their hydrogen susceptibility based on the crack growth results. Design curves determined from the SN test results are compared with various standard design curves. ESA

N93-20350# Warsaw Univ. (Poland). Inst. of Heavy Machinery Engineering.

FATIGUE DESIGN OF EARTHMOVING MACHINES

W. Sobczykiewicz, Hieronim Jakubczak, and G. Glinka (Waterloo Univ., Ontario.) *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 2 1992 p 283-297 (For primary document see N93-20330 07-39)

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Methods of fatigue life predictions recommended for the design and development of earthmoving machines are presented. The procedure is complemented with a software package for fatigue life calculations consisting of three programs: FALSN, FALIN and FALPR. They are based on the S-N, notch strain and fracture mechanics approach respectively. An example of fatigue designing at the preliminary design stage is also presented. ESA

N93-20351# Warsaw Univ. (Poland). Inst. of Heavy Machinery Engineering.

SERVICE LOADING OF WORK ATTACHMENTS OF HYDRAULIC EXCAVATORS

W. Sobczykiewicz *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 2 1992 p 299-310 (For primary document see N93-20330 07-39)

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Loading data for work attachments of hydraulic excavators acquired in service in various operating conditions are presented. The data was processed in order to obtain load distributions and can be used for fatigue dimensioning of work attachments of hydraulic excavators at the preliminary design stage. In addition, a proposal was made on how to select the number of load cycles as the required fatigue life of work attachments. ESA

N93-20352# Warsaw Univ. (Poland). Inst. of Heavy Machinery Engineering.

COMPUTER AIDED PLANNING OF LABORATORY TESTS OF EXCAVATOR ATTACHMENTS

Hieronim Jakubczak *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 2 1992 p 311-319 (For primary document see N93-20330 07-39)

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A laboratory test preparation of excavator work attachment is discussed. The problem of how to select the attachment configuration for testing the whole attachment assembly (boom, arm and bucket) is proposed to be solved with the aid of the software package RODOS. The software enables the analyses from the scope of kinematics, kinetics and strength. ESA

N93-20353# Technical Research Centre of Finland, Espoo. Metals Lab.

FATIGUE ASSESSMENT OF A CAST COMPONENT FOR A TIMBER CRANE

Aslak Siljander, Mikko Lehtonen, Gary Marquis, Jussi Solin, Jukka Vuorio, and Pentti Tuononen *In its* Fatigue Design 1992, Volume 2 1992 p 321-335 (For primary document see N93-20330 07-39)

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The fatigue life assessment of a cast slewing system base which is one of the primary load carrying components in log loaders is described. Field measurements were conducted and strain histograms were produced to quantify the required fatigue strength for the next generation of components made of a new material and with larger payload capacities. Finite element analyses of the cast base subjected to the measured external loads provided vital information on the stress and strain distributions for subsequent fatigue life assessment and allowed alternate designs to be simulated rapidly. Recommendations on the geometry of the new component could be made early in the product design cycle when these design integrated approaches were incorporated. ESA

N93-20354# Central-South Univ. of Technology, Changsha (China). Dept. of Applied Mathematics and Mechanics.

THERMAL PLASTIC STRAIN FATIGUE LIFE OF THE ROLL

Zhenzi Li, Xiangan Huang, and Fuchang Liao (Shenzhen School of Technology, Guangdong, China.) *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 2 1992 p 337-341 (For primary document see N93-20330 07-39)

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Fracture mechanics are applied to the roll, a crucial part of a mill, in order to solve engineering problems. The calculations of the thermal stress fields and temperature field are outlined. The estimation of the thermal plastic strain fatigue life of the roll, using Neuber's plastic stress-strain concentration theory, a path independent J integral defined by Rice, and cyclic strain growth rates, is shown. ESA

N93-20355# Slovak Academy of Sciences, Bratislava (Czechoslovakia). Inst. of Materials and Mechanics of Machines.

SOME FACTORS INFLUENCING THE FATIGUE PROPERTIES OF BORON STRENGTHENED ALUMINUM BASED COMPOSITE MATERIALS

Ladislav Taborsky and Pavol Sebo *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 2 1992 p 343-351 (For primary document see N93-20330 07-39)

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The influence of interfacial bond strength in the boron fibers of reinforced 6061 aluminum composite materials on the fatigue strength of that material was studied. Composite materials prepared by hot pressing at 723K, characterized by insufficient bonding of the matrix with the fibers, resulted in the highest fatigue strength. Composite materials with good bonding (773K) resulted in optimum tensile as well as shear strength and lower fatigue strength (about 22 percent). A method to evaluate the quality of bonding of composite material components, consisting of shear strength measurement and scanning electron microscope observations was used. Interface bonding strength determines the failure mechanisms of the fatigue process. Volume amount and strength of the reinforcing fibers influences the fatigue properties of composite materials. ESA

N93-20356# Lappeenranta Univ. of Technology (Finland). Dept. of Mechanical Engineering.

ASPECTS OF GOOD DESIGN PRACTICE FOR FATIGUE-LOADED WELDED COMPONENTS

Erkki Niemi *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 2 1992 p 353-375 (For primary document see N93-20330 07-39)

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The importance of understanding the various sources of stress concentrations is discussed. The structural discontinuities are classified into three categories and the significance of the distinction on the fatigue analysis is explained. Various methods of solving structural stresses at the hot spots are discussed. The various ways to improve the design are explained in the light of fracture mechanics. Some recommendations are given for the treatment of variable amplitude loading. ESA

N93-20357# Stuttgart Univ. (Germany). Staatliche Materialpruefungsanstalt.

CYCLIC MATERIAL PROPERTIES AT HIGH STRAIN RANGES BEYOND THE STANDARD DESIGN CODES

Karl Maile, Klaus Bothe, Dieter Blind, and Georg Vazoukis (Siemens A.G., Erlangen, Germany.) *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 2 1992 p 377-388 (For primary document see N93-20330 07-39)

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Low cycle fatigue tests were performed at characteristic temperatures on materials employed in nuclear piping systems. The influence of strain rate, temperature, surface roughness, notches and welding on the number of cycles to crack initiation and failure were investigated in the high strain range regime. The crack initiation does not depend significantly on the strain rate, the surface conditions and the temperature. The fatigue endurance of notched specimens cannot be satisfactorily compared with that of smooth specimens. The influence of welding depends on the material. The results of the smooth specimens lie above the design curves of TRD, KTA and ASME code. ESA

N93-20368*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

STRUCTURAL DYNAMICS BRANCH RESEARCH AND ACCOMPLISHMENTS TO FY 1992

Charles Lawrence Dec. 1992 39 p

(RTOP 505-63-513)

(NASA-TM-105824; E-7237; NAS 1.15:105824) Avail: CASI HC A03/MF A01

This publication contains a collection of fiscal year 1992 research highlights from the Structural Dynamics Branch at NASA LeRC. Highlights from the branch's major work areas--Aeroelasticity, Vibration Control, Dynamic Systems, and Computational Structural Methods are included in the report as well as a listing of the fiscal year 1992 branch publications. Author

N93-20585*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF DYNAMIC CHARACTERISTICS OF EXTENSION-TWIST-COUPLED COMPOSITE TUBULAR SPARS

Renee C. Lake, Amir P. Izadpanah (Sterling Software, Palo Alto, CA.), and Robert M. Baucom Washington Feb. 1993 59 p Original contains color illustrations

(Contract DA Proj. 1L1-62211-A-47-AB; RTOP 505-63-36-01)

(NASA-TP-3225; L-16950; ARL-TR-30; NAS 1.60:3225) Avail: CASI HC A04/MF A01; 5 functional color pages

The results from a study aimed at improving the dynamic and aerodynamic characteristics of composite rotor blades through the use of extension-twist coupling are presented. A set of extension-twist-coupled composite spars was manufactured with four plies of graphite-epoxy cloth prepreg. These spars were noncircular in cross-section design and were therefore subject to warping deformations. Three different cross-sectional geometries were developed: D-shape, square, and flattened ellipse. Three spars of each type were fabricated to assess the degree of repeatability in the manufacturing process of extension-twist-coupled structures. Results from free-free vibration tests of the spars were compared with results from normal modes and frequency analyses of companion shell-finite-element models. Five global modes were identified within the frequency range from 0 to 2000 Hz for each spar. The experimental results for only one D-shape spar could be determined, however, and agreed within 13.8 percent of the analytical results. Frequencies corresponding to the five global modes for the three square spars agreed within 9.5, 11.6, and 8.5 percent of the respective analytical results and for the three elliptical spars agreed within 4.9, 7.7, and 9.6 percent of the respective analytical results. Author

N93-20616 Manitoba Univ., Winnipeg.

PROCEEDINGS OF THE THIRTEENTH CANADIAN CONGRESS OF APPLIED MECHANICS, VOLUMES 1 AND 2

N. Popplewell, ed. and A. H. Shah, ed. May 1991 864 p Congress held in Winnipeg, Manitoba, 2-6 Jun. 1991

(ISBN-0920049-04; CTN-93-60603) Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

These proceedings cover a wide range of topics of interest to mechanical engineers, including developments in modeling and theory, analytical and numerical techniques, investigations into the behavior of engineering materials, and applications of mechanics. Fluid mechanics was a major focus of this conference. Sessions focusing on modeling and theory covered the following topics: solid mechanics, fluid-structure interaction, theory and modeling of elasticity, viscoelasticity and plasticity, structural dynamics and vibrations, dynamics of plates and shells, structural stability, fracture and fatigue mechanics, crack mechanics, biomechanics, and mechanics of membranes and cable networks. Sessions on fluid mechanics were included, as were sessions on robotics, CAD/CAM, space vehicle mechanics, materials and their testing, composite materials, joints, and laminated structures. For individual titles, see N93-20617 through N93-20730.

N93-20617# British Columbia Univ., Vancouver. Dept. of Mechanical Engineering.

COMPUTATIONAL FLUID FLOW AND HEAT TRANSFER. AN ENGINEERING TOOL **c34**

Martha Salcudean *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 34-44 (For primary document see N93-20616 07-39)

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The purpose, method, and potential of computational fluid dynamics (CFD) are discussed. Some examples of CFD and heat transfer applied to engineering problems are described. Simulation of casting in a permanent mold, gallium arsenide crystal growth, and the computation of discharge coefficients in film cooling of turbine blades are briefly described. It is shown the the CFD methods help to improve the understanding of the physics involved. They allow the influence of various parameters on the product or process to be investigated in a relatively inexpensive way. CFD constitutes a predictive tool which allows for product or process optimization. Discretization and solution methods used in the present examples are briefly described. Some limitations of the CFD methods are illustrated. The error introduced by false diffusion is shown for laminar flow around a bluff body. The improvement obtained by a higher order scheme is discussed. Some difficulties related to turbulence modelling are illustrated for the flow and heat transfer around the same bluff body. Turbulent swirling flow between concentric annuli is also discussed. Problems related to the slow convergence rate and major improvements obtained through applying multigrid convergence acceleration methods are shown for two and three dimensional opposing jets penetrating into a main flow. Author (CISTI)

N93-20618# University Coll. of Swansea (Wales).

ADAPTIVITY-FLUIDS-LOCALIZATION. THE CHALLENGE TO COMPUTATIONAL MECHANICS **c34**

O. C. Zienkiewicz *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 46-53 (For primary document see N93-20616 07-39)

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Three areas in computational mechanics which have practical importance are discussed and are shown to be to some extent interdependent. These areas are as follows: (1) adaptive, automatic refinement which permits error control of the approximation inherent in all discretized solutions; (2) satisfactory approximation to convection dominated problems of fluid mechanics, where the optimality of Galerkin type approximation does not necessarily exist; and (3) the numerical treatment of discontinuities (or

localization) such as occur in many problems of solid mechanics with softening behavior and compressible fluids where shock formation develops. Here the continuous finite element approximation introduces obvious difficulties. In particular, the adaptive procedures of general applicability have a substantial role to play in both fluid mechanics and the localization occurring in both fluids and solids. This interaction may result in rapid progress in the whole spectrum of problems covered as research information becomes transferred from one area to another. Author (CISTI)

N93-20619# Victoria Univ. (British Columbia). Dept. of Mechanical Engineering.

THE ROLE OF LEAST SQUARES IN VARIATIONAL PRINCIPLES OF ELASTICITY

B. Tabarrok and S. Dost *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 66-69 (For primary document see N93-20616 07-39)

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A rationale for a new formulation of the equations of elasticity is presented. A formulation, based on the least squares method, is developed for both the linear and the nonlinear cases. The nonlinear cases involve large deformations and material nonlinearity. The governing equations of elasticity may be grouped into three sets: the equilibrium equations in terms of stress components, compatibility equations in terms of strain components, and constitutive equations relating the stress and strain components. The first two sets of equations are mathematical and therefore exact, while the latter is physical and inherently approximate. It is argued that one should satisfy the exact equations identically and place any errors of approximation in the constitutive equations. The equilibrium and compatibility equations are differential equations, whereas the constitutive equations are usually algebraic. Recognizing that errors in derivatives of an approximation function are generally larger than those in the function itself, it follows that, given the choice, the differential equations should be satisfied a priori, and the algebraic equations should be satisfied approximately in the extremization process. Using the above rationale the author introduces a new variational statement, the extremum conditions of which turn out to be identical to those of the minimum potential energy principal and those of its complementary form. The new formulation which is based on the least squares method is shown to contain the two classical formulations as subsets. Author (CISTI)

N93-20620# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.

A NON-LINEAR PHENOMENON IN THE DYNAMIC RESPONSE OF METALLIC AND COMPOSITE STRUCTURES

Dean T. Mook *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 70-72 (For primary document see N93-20616 07-39)

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This paper compares the responses of metallic and composite structural beams to a harmonic excitation, especially when the frequency of the excitation is near one of the natural frequencies. Both structures exhibited unusual behavior, but the behaviors of the two were different. The motion of the metallic structures was always planar. The torsional stiffness was so great that no torsional frequencies were comparable to the lower flexural frequencies. For one of the composite beams the second natural frequency in flexure was approximately twice the first natural frequency in torsion and three times the first natural frequency in flexure. When excited to the second natural frequency the flexural and torsional modes were coupled, and violent out of plane motion developed as a result of twisting of the horizontal beam. Glued joints failed as soon as out of plane motion began. This example serves to illustrate the need to consider nonlinear effects in the dynamic responses of rather flexible structures and the importance of considering details of the material properties. Nonlinear behavior can appear at such low amplitudes that there is virtually no linear behavior.

Author (CISTI)

N93-20621# Institut de Recherche de l'Hydro-Ontario, Toronto.

THE ARK (AUTONOMOUS ROBOT FOR A KNOWN ENVIRONMENT) PROJECT **c37**

S. B. Nickerson, F. Camacho, D. L. Mader, E. E. Milios (Toronto Univ., Ontario.), M. R. M. Jenkin (York Univ., Downsview, Ontario.), N. Bains (Atomic Energy of Canada Ltd., Sheridan Park, Ontario.), P. Braun (Atomic Energy of Canada Ltd., Sheridan Park, Ontario.), D. Green (National Research Council of Canada, Ottawa, Ontario.), S. Hung (National Research Council of Canada, Ottawa, Ontario.), and L. Korba (National Research Council of Canada, Ottawa, Ontario.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 76-77 (For primary document see N93-20616 07-39)

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The main goal of the project is to build a mobile robot that can navigate in a known indoor environment using computer vision as its main sensor, with the aid of an internal geometric model of its environment. A second goal is to explore the technology in such a way as to best illustrate its usefulness and commercial potential. The theory will focus on the development and testing of computer vision algorithms as aids for robot navigation. Two robots will be built: ARK-1 (autonomous robot for a known environment); and ARK-2. ARK-1 will be tethered and will be used to test the vision algorithms. ARK-2 will be untethered, will use other sensors in addition to vision, will have a real-time operating system and will operate in an industrial environment. The platforms for both ARK- 1 and ARK-2 will be the same as that of a robot being developed at NRC for industrial applications. Author (CISTI)

N93-20622# Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.

THE PRACTICAL APPLICATION OF COMPUTATIONAL FLUID MECHANICS **c34**

G. D. Raithby and P. F. Galpin (Advanced Scientific Computing Ltd., Waterloo, Ontario.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 78-81 (For primary document see N93-20616 07-39)

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An overview of the diverse methods used in computational fluid dynamics (CFD) is presented. Conservation of mass, momentum, energy, and species form a closed set of equations if the constitutive relations for fluid stress, heat transfer, and mass transfer are provided. Discretization methods for the continuous equations are described including the method of weighted residuals, domain subdivision, and finite element methods. The major methods for developing computation grids are discussed along with their constraints. Several CFD applications are discussed and example computational grids are provided. Included are flow around a fin, flow through a vessel and pipes, flow through a combustor, and flow through a complex impeller. Author (CISTI)

N93-20623# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

ADVANCED INDUSTRIAL MATERIALS. AN OVERVIEW **c24**

R. C. Tennyson *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 88-93 (For primary document see N93-20616 07-39)

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A brief overview is provided of the major thrusts currently underway in the development of advanced materials. Discussions include the following: (1) a comparison of the processing properties of thermoplastic and thermoset polymer matrix composites; (2) a description of self reinforcing polymers (molecular composites); and (3) ceramics and ceramic matrix composites, and alloys and metal matrix composites. Nominal service temperatures of various materials together with a brief summary of their mechanical properties are provided. Examples are given of property variation with temperature for a range of advanced materials. Variations in the coefficient of thermal expansion are listed for several materials including composites as a function of material stiffness and density. Author (CISTI)

N93-20624# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

SMART MATERIALS **c24**

Raymond M. Measures *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 94-96 (For primary document see N93-20616 07-39)

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Smart material technology will require the development of structurally integrated fiber optic reticulate sensor (SIFORS) technology. Improved safety would follow from real-time continuous surveillance of structural integrity of each critical component as well as from better quality control during fabrication. Also since structural weaknesses would be indicated before they become critical this could allow longer periods between major and costly inspections and a shorter downtime since the built-in sensors would

have already indicated sites of weakness and their rate of deterioration prior to inspection. An overview of the new field of smart materials is presented and research towards the development of the required structurally integrated fiber optic sensors is reviewed. This includes the development of the first full-scale fiber optic damage assessment test system in the form of a composite aircraft leading edge and the fabrication, characterization and evaluation of the first fiber optic strain rosette. Author (CISTI)

N93-20625# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
THERMOPLASTIC COMPOSITES **c24**
W. J. Unger, H. Y. S. Ko, and J. S. Hansen *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 98-101 (For primary document see N93-20616 07-39)
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The recent availability of high performance continuous fiber reinforced thermoplastic pre-pregs has spawned considerable research and industrial development related to their characterization and utilization. A comparison between thermoset and thermoplastic composites is presented. Research results based on the unique attributes of thermoplastic composites are presented. Two projects are discussed. The first exploits the possibility of applying heat and pressure to a thermoplastic composite structure to eliminate or heal damage. The second project considers application of localized heat treatment in order to enhance material properties. In particular, it is demonstrated that appropriate remelting and/or heat treatment of the material can result in residual stress changes which can enhance the failure characteristics of the laminates considered. In both cases this has expanded the capability of the material and further emphasizes a potential advantage to be gained from the use of thermoplastic composites.
Author (CISTI)

N93-20626# Manitoba Univ., Winnipeg. Dept. of Mechanical Engineering.
HIGH TEMPERATURE ALLOYS **c26**
M. C. Chaturvedi, N. L. Richards (Bristol Aerospace Ltd., Winnipeg, Manitoba.), and R. Nakkalil *In its* Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 102-113 (For primary document see N93-20616 07-39)
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A review is presented of high temperature alloys which can be used as structural materials. The focus is primarily on the advances on superalloys and on ordered intermetallics. Superalloys are high strength heat resistant alloys based on Group 8A elements. The main element in the matrix components may be nickel, nickel-iron and iron, or cobalt. This report discusses the state of the art in processing of a variety of superalloys. The advances in critical properties which were achieved by various alloys are listed. These properties include, elastic constants, resistance to time dependant plastic deformation and rupture, retention of adequate ductility, tensile and impact properties, resistance to cyclic variations in stress and temperature, resistance to chemical attack, and ease of material fabrication and joining. Also reviewed is the ongoing research and status of ordered intermetallics. Intermetallics are of interest because of their high strength, high melting point, low density, good corrosion and oxidation resistance, and good creep resistance. A bibliography of articles related to processing of superalloys and intermetallics is included. Author (CISTI)

N93-20627# Toronto Univ. (Ontario). Dept. of Metallurgy and Materials Science.
ADVANCED STRUCTURAL CERAMICS **c27**
T. W. Coyle *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 114-115 (For primary document see N93-20616 07-39)
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A brief overview is provided of the techniques and technologies currently being developed for the processing and forming of advanced technical ceramics. Also provided is a review of the market response to these developments. The market for these ceramics has grown recently due to real improvements in fabrication techniques and in mechanical performance. The basis for this improvement is a better understanding and control of the relationships between ceramic processing and microstructural development of mechanical properties. A full understanding of the entire fabrication process is required if the level of microstructural control required to reliably produce high performance materials is to be attained. Vital powder characteristics such as particle size distribution, chemical homogeneity, and high purity continue to improve. Forming processes that take advantage of improved powder quality and ceramic densification are under development. Significant development was made in defining microstructural parameters that enhance specific aspects of behavior.
Author (CISTI)

N93-20628# National Research Council of Canada, Ottawa (Ontario). Inst. for Aerospace Research.
FLUID/STRUCTURES INTERACTIONS. AIRCRAFT CONSIDERATIONS **c08**
B. H. K. Lee *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 120-122 (For primary document see N93-20616 07-39)
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The Institute of Aerospace Research (IAR) has an active ongoing program in aeroelastics. This paper describes research being conducted on buffeting and on flutter of aircraft structures. Buffeting is almost always encountered when an aircraft approaches the limit of usable lift at high speeds thus limiting the maneuverability of the aircraft. Methods of predicting the buffet intensity as the aircraft penetrates into the buffet regime are very useful in aircraft design. A model was developed which analyzes the coupling between the structural vibration and aerodynamics of the oscillating wing. A procedure used in calculating the response of a wing to random loading with aerodynamics is discussed. The methodologies, models, and computer codes used in flutter analysis procedures are described. The commercial MSC/NASTRAN finite element structural analysis program is used in calculation of the mode shapes. A three dimensional computer code capable of modeling complex aircraft configurations is used to model the unsteady aerodynamic forces. A flutter code was developed at IAR which has the capability of performing analyses at subsonic, transonic, and supersonic speeds. Author (CISTI)

N93-20629# McMaster Univ., Hamilton (Ontario). Dept. of Mechanical Engineering.
FLUID/STRUCTURE INTERACTIONS. INTERNAL FLOWS **c34**
D. S. Weaver *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 130-134 (For primary document see N93-20616 07-39)
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Flow-induced vibrations are found wherever structures are exposed to high velocity fluid flows. Internal flows are usually characterized by the close proximity of solid boundaries. There are surfaces against which separated flows may reattach, or from which pressure disturbances may be reflected resulting in acoustic resonance. When the fluid is a liquid, the close proximity of solid boundaries to a vibrating component can produce very high added mass effects. This paper presents three different experimental studies of flow-induced vibration problems associated with internal flows. The emphasis was on experimental techniques developed for understanding excitation mechanisms. In difficult flow-induced vibration problems, a useful experimental technique is flow visualization using a large scale model and strobe light triggered by the phenomenon being observed. This should be supported by point measurements of velocity and frequency spectra. When the flow excitation is associated with acoustic resonance, the sound can be fed back to enhance or eliminate the instability. This is potentially a very useful tool for studying and controlling fluid-structure interaction problems. Some flow-induced vibration problems involve a number of different excitation mechanisms and care must be taken to ensure that the mechanisms are properly identified. Artificially imposing structural vibrations or acoustic fields may induce flow structures not naturally present in the system. Author (CISTI)

N93-20630# Waterloo Univ. (Ontario). Dept. of Civil Engineering.
FURTHER DEVELOPMENTS IN SHAPE OPTIMIZATION OF STRESS CONCENTRATION REGIONS. PART 1: GENERAL THEORY
O. K. Bedair and J. C. Thompson *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 144-145 (For primary document see N93-20616 07-39)
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Cyclic loading of structural components may lead to the development of fatigue cracks in stress concentration regions (SCR). Whenever the consequences of such cracks are serious, substantial extra cost and effort

may be expended by the designers to delay crack initiation by optimizing the shape of the SCR so as to minimize the peak stress. This paper describes a sequential linear programming-based technique and presents approximation techniques to minimize computation time. The boundary element technique required for shape optimization may be prohibitively expensive. Two techniques which substantially reduce the cost are described. One technique reduces the cost of optimization of each iteration by a factor of (lambda(N) = 1)/(N+1), where lambda is a parameter which depends on details of the particular application. A second modification reduces the computation time by a further factor of at least 50 percent.
Author (CISTI)

N93-20631# Waterloo Univ. (Ontario). Dept. of Civil Engineering.
FURTHER DEVELOPMENTS IN SHAPE OPTIMIZATION OF STRESS CONCENTRATION REGIONS. PART 2: APPLICATIONS
O. K. Bedair and J. C. Thompson *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 146-147 (For primary document see N93-20616 07-39)
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Cyclic loading of structural components may lead to development of fatigue cracks in stress concentration regions (SCR). Whenever the consequences of such cracks are serious, substantial extra cost and effort may be expended by the designers to delay crack initiation by optimizing the shape of the SCR so as to minimize the peak stress. A sequential linear programming-based technique and two approximation techniques were developed to minimize computation time. In this paper these techniques are applied to a specific example. The optimized shape is determined for various relative intensities of the symmetric and antisymmetric components of the stress field in the stress concentration region. The results are generalized to any geometrically similar SCR, thus virtually eliminating the computational cost of optimizing such regions. Author (CISTI)

N93-20632# Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
ON THE EXTENSION OF ASYMPTOTIC ANALYSIS TECHNIQUES TO GEOMETRICALLY COMPLICATED STRESS CONCENTRATION REGIONS
J. L. Desjardins, J. C. Thompson, and D. J. Burns *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 150-151 (For primary document see N93-20616 07-39)
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Stress concentration regions are often points for fatigue cracks in cyclically loaded components and structures. For complicated loadings and/or geometries, numerical and experimental techniques must be used to determine stress concentration factors. The asymptotic analysis technique provides a powerful means of circumventing the limitations of the above techniques. The essence of this technique is the ability to express the local stress, strain, or displacement fields as the sum of an infinite series of modes. This paper describes how the dominant asymptotic modes can be determined for any arbitrarily shaped stress concentration region. The algorithm uses numerical or experimental data obtained for a variety of loadings, but requires no a priori knowledge of the mode shapes. The extracted mode shapes are smooth and highly accurate, even when a relatively small number of moderately accurate data are used. Once the asymptotic mode shapes are found for a particular notch geometry, these can be used to analyze data from any component or structure with a geometrically similar notch, completely circumventing the need for a costly boundary element or finite element analysis with a very fine mesh.
Author (CISTI)

N93-20633# Institut National des Sciences Appliquees, Toulouse (France).
A VARIATIONAL APPROACH FOR TORSION OF MULTIPLY CONNECTED COMPOSITE SECTIONS **c24**
R. A. Daoud and E. Ramahefarison *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 160-161 (For primary document see N93-20616 07-39)
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A procedure for using a mixed variational method of least square type to treat uniform torsion of anisotropic sections with cavities is illustrated. The formulation associates, in the equivalent isotropic cross section, Saint-Venant's kinematic method using the warping function and the static method using a secondary torsional stress function. The minimization of the mixed functional is equivalent to solve, by a single process, these two problems. An analogy with plane elasticity problems provides an easy way to obtain numerical solutions via finite element method introducing an equivalent behavior. This method gives a bracketing of the solution, in particular a lower and an upper bound of the torsional rigidity. It equally allows, by a numerical process, the shear strains and the shear stresses, the constants on the partial contours of a multiply connected domain, and the polar moment of inertia of the cross section. Author (CISTI)

N93-20634# Obafemi Awolowo Univ., Ile-Ife (Nigeria). Dept. of Mathematics.
ON HOMOGENIZATION METHOD AND LARGE DEFORMATIONS **c24**
A. Akinola *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 162-163 (For primary document see N93-20616 07-39)
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The homogenization of heterogeneous (composite) media is done either through the energy function, for which the variational principle is invoked, or through the equation of state, that is a motion equation or static equation where the asymptotic averaging method (AAM) is involved. Here the second approach is adopted. The equation of mathematical physics with variable coefficients is converted to equations with constant coefficients. In this approach, the most effective mathematical basis, with respect to the homogenization theory, is the distribution theory. The theory is built on the concept of dual spaces and weak topology. On the basis of this theory a number of specific problems are considered (simple shear, torsion, uniform compression) which are fundamental in engineering designs. In doing so the analogue of the semi-inverse method was followed: specify geometry of deformation, and construct (or apply, if any) the energy function.
Author (CISTI)

N93-20635# Saskatchewan Dept. of Mineral Resources, Regina. Dept. of Mechanical Engineering.
AN ITERATIVE APPROACH TO CURVED RAY PHOTOELASTIC ANALYSIS
A. T. Dolovich and G. M. L. Gladwell (Waterloo Univ., Ontario.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 168-169 (For primary document see N93-20616 07-39)
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Transmission photoelasticity has long been regarded as an important, well established tool for the experimental determination of stress fields in solid bodies. Contemporary applications include the analysis of aircraft engine parts as well as the determination of stress fields in the vicinity of crack tips. In recent literature, however, the theoretical foundations for this optical method have come into question. In particular, the classical assumption that light propagates rectilinearly through a photoelastic body appears to be unreasonable for the reconstruction of precisely those regions which are normally the most critical in an engineering analysis; that is, regions of high stress gradient. Here, the ramifications of nonrectilinear light propagation are briefly discussed, and an iterative approach for incorporating the effects due to ray bending is proposed. Closely related disciplines such as holographic interferometry and geophysical imaging are then identified to demonstrate that photoelasticity may be regarded as a special case within a more general set of problems, which may be described as inverse problems in curved ray tomography. Author (CISTI)

N93-20636# Sheffield Univ. (England). Dept. of Mechanical and Process Engineering.
THE USE OF PHASE-STEPPING IN THE PHOTOELASTIC ANALYSIS OF COMPLEX COMPONENTS
E. A. Patterson and Z. F. Wang *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 170-171 (For primary document see N93-20616 07-39)
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The use of photoelasticity is severely hampered by the tedium involved and the time required for a well-trained operator to obtain and interpret results. An automatic full-field system capable of handling slices from complex three dimensional photoelastic models has not been developed. The analysis of these shapes for which there often exist a theoretical solution is an important step in assessing the performance of an automated system. This paper presents a phase stepping approach to the photoelastic

analysis of complex components. The method was applied to a stress frozen slice from a nut-bolt connection loaded in tension. Contour maps are presented of the isoclinic parameter, theta, and the periodic isochromatic, alpha. A contour map of the wrapped, or continuous isochromatic parameter is shown. The complexity and density of the isochromatic fringes around the thread roots do not represent any difficulty to the determination of isochromatic parameter. However, the density of the fringes does affect the determination of an isoclinic parameter. In conclusion, the phase stepping technique has the potential to produce detailed maps of the photoelastic parameters in complex components. However, some problems remain to be solved before an operational system is available. Author (CISTI)

N93-20637# Boliden Allis Canada, Inc., Kirkland (Ontario).
PARALLEL AXES GEAR SET OPTIMIZATION IN TWO-PARAMETER SPACE **c37**
Y. Theberge, A. Cardou (Laval Univ., Quebec.), and L. Cloutier (Laval Univ., Quebec.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 174-175 (For primary document see N93-20616 07-39)
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This paper presents a method for optimal spur and helical gear transmission design that may be used in a computer aided design (CAD) approach. The design objective is generally taken as obtaining the most compact set for a given power input and gear ratio. A mixed design procedure is employed which relies both on heuristic considerations and computer capabilities. Strength and kinematic constraints are considered in order to define the domain of feasible designs. Constraints allowed include: pinion tooth bending strength, gear tooth bending strength, surface stress (resistance to pitting), scoring resistance, pinion involute interference, gear involute interference, minimum pinion tooth thickness, minimum gear tooth thickness, and profile or transverse contact ratio. A computer program was developed which allows the user to input the problem parameters, to select the calculation procedure, to see constraint curves in graphic display, to have an objective function level curve drawn through the design space, to point at a feasible design point and to have constraint values calculated at that point. The user can also modify some of the parameters during the design process. Author (CISTI)

N93-20638# University of South Florida, Tampa. Dept. of Civil Engineering and Mechanics.
VISCOELASTIC ANALYSIS OF BONDED CONNECTIONS
William C. Carpenter *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 184-185 (For primary document see N93-20616 07-39)
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Analysis of bonded configurations is made difficult because of the thin adhesive layer and the stress singularities which exist at the edges of bonded configurations at the bimaterial interfaces. This paper is concerned with the use of lap joint theories with regard to viscoelastic analysis of adhesively bonded configurations. Viscoelastic analyses of adhesively bonded joints were performed using the Laplace transform technique. The inverse transforms were obtained numerically. The results have become the benchmark against which other numerical results are compared. In this analysis, control parameters are set to exactly duplicate the assumptions of the earlier work. The analysis is advanced with time using the Runge-Kutta integration formula in a direct integration procedure. The direct integration procedure has the advantage that it is computationally simple, has minimal storage requirements, and requires very little programming effort to transform an elastic analysis algorithm into a viscoelastic analysis algorithm. The results obtained with the finite element analysis algorithm described are effectively identical to those of the earlier work. Author (CISTI)

N93-20639# Ecole Polytechnique, Montreal (Quebec).
CREEP DAMAGE OF CARBON FIBER REINFORCED PEEK [ENDOMMAGEMENT EN FLUAGE DU PEEK RENFORCE PAR DES FIBRES DE CARBONE] **c27**
H. Ould Brahim, T. Vu Khanh, and R. Gauvin *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 188-189 In FRENCH (For primary document see N93-20616 07-39)
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Recent developments in thermoplastic resins and impregnation techniques have created a new generation of composites. APC-2 is a polyether ether ketone (PEEK) based composite composed of 60 percent unidirectional continuous carbon fibers preimpregnated with PEEK. The thermoplastic nature of PEEK also results in a low creep resistance, particularly at high temperatures. The understanding of the long term mechanical behavior of APC-2, which is critical for structural applications, is the focus of the work presented here. In particular, the evolution of viscoelastic properties in the critical transverse direction as a result of creep is analyzed under different constraints and at different temperatures. This study showed excellent creep resistance in the transverse direction up to a temperature of 120 C. A linear creep behavior, hence the possibility of interpolation of creep properties, was shown. The study has revealed a nonlinear influence of damage on creep behavior. While confirming a general pattern of damage similar to that of other composites, the importance of the mechanism of deformation with respect to the choice of damage parameters was highlighted. Rupture seemed to be governed by the cumulative damage rather than by the activation energy process often used to predict the long term static rupture. Interface rupture was observed at a specific temperature of near 120 C. Author (CISTI)

N93-20640# Ecole Polytechnique, Montreal (Quebec).
NONHOMOGENEOUS INTERFACE STRESS ANALYSIS IN COMPOSITE MEDIA USING A MIXED FINITE ELEMENT FORMULATION
A. Shirazi-Adl and B. Chouchaoui *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 190-191 (For primary document see N93-20616 07-39)
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The compatible finite element formulation often results in discontinuous stresses at the element boundaries. This violation of the local equilibrium becomes evident especially at the bimaterial interfaces. The present work deals with the development of a mixed finite element formulation based on the Hellinger-Reissner variational principle and its evaluation for the stress analysis of nonhomogeneous interfaces. In order to avoid unnecessary constraint on some stress components, as many super-elements as the number of regions with different materials are first constructed. These are then assembled after condensing the discontinuous stress degrees of freedom at the common interfaces. At the end prior to the solution, the kinematic boundary conditions are satisfied, whereas the stress boundary conditions are either enforced or left unknown in the analysis. The mixed method performs well for the stress computation at the interface of highly dissimilar materials. In the absence of more accurate methods, the stress predictions of the compatible finite element method for the softer side of a bimaterial interface appear to be generally more reliable than those for the harder side. Author (CISTI)

N93-20641# Naval Postgraduate School, Monterey, CA. Dept. of Mechanical Engineering.
MATERIAL NONLINEAR ANALYSIS OF COMPOSITES
Y. W. Kwon *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 192-193 (For primary document see N93-20616 07-39)
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A three dimensional analysis model was developed for the material nonlinear analysis of continuous fiber reinforced composite plates. The respective yield criterion and flow rule or each constituent, namely fiber or matrix, can be used in the model instead of those for the globally smeared anisotropic material. The respective stresses occurring on each constitutent can also be obtained directly from the present model. The model was degenerated into a plate bending analysis model and a two dimensional analysis model. A finite element formulation was derived from the analysis model. Application of the present analysis model along with the finite element formulation to the material nonlinear analyses of composites provided good solutions. Some examples of composite plate bending were solved using the present formulation. Author (CISTI)

N93-20642# Moncton Univ. (New Brunswick).
RELIABILITY OF FAILURE ENVELOPES FOR COMPOSITE MATERIALS
P. Labossiere and S. Leblanc *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 194 (For primary document see N93-20616 07-39)
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Predicting the mechanical behavior of new anisotropic materials has

gained an increasing importance in recent years. Thin, orthotropic composite laminae, reinforced uni-directionally or bi-directionally, are considered in this article. In most structural applications, many laminae with different orientations are assembled together to form a laminate. This one is generally subjected to bending and in-plane loading and can often be analyzed under the assumption of plane stress conditions. This requires definition of the strength properties of a particular lamina. Strength or failure theories are employed for this purpose. The application method is limited to the tensor polynomial theory. The purpose of this article is to show how the selection of parameters in a failure criterion can be made to improve this criterion's overall reliability. The proposed method is applied to paperboard. Author (CISTI)

N93-20643# Okayama Univ. of Science (Japan). Dept. of Mechanical Engineering.

DYNAMIC STRESS-STRAIN BEHAVIOR IN SHEAR OF SiCWHISKER REINFORCED ALUMINUM ALLOY COMPOSITES

T. Yokoyama *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 196-197 (For primary document see N93-20616 07-39)

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The strengthening effects in view of the dynamic mechanical properties of SiC whisker reinforced aluminum alloy composites are not well understood at present. The objectives of the present study are to determine the dynamic stress-strain characteristics of SiC/6061-T6 Al alloy composites and to analyze the strengthening mechanisms due to the SiC whisker reinforcement. A series of torsional impact tests was conducted on SiC/6061-T6 Al alloy composite specimens. The dynamic stress-strain was compared with the corresponding static stress-strain. The SiC/6061-T6 Al alloy composite displays a strain-rate sensitivity. A rapid decrease in the stress level of the static curve corresponds to fracture initiation within the gage length of the specimen. In contrast, there is a negligible amount of strain-rate sensitivity up to a shear strain rate of approximately 1700 per second. The strain rate dependence of the flow stress in the SiC/6061-T6 Al alloy composite is attributed to the dynamic interface interactions between the SiC whiskers and the matrix alloy. Author (CISTI)

N93-20644# Federal Pioneer Ltd., Winnipeg (Manitoba).

CREEP OF PEEK-GRAPHITE FIBRE COMPOSITE MATERIAL

Jonathan Enns and J. R. Cahoon (Manitoba Univ., Winnipeg.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 198-199 (For primary document see N93-20616 07-39)

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The thermoplastic matrix composites are a relatively new class of materials and their mechanical properties have not yet been fully characterized. Therefore, a study was initiated to determine the high temperature creep behavior of polyether ether ketone (PEEK) matrix-graphite fiber composites, one of the new thermoplastic matrix composites. The samples were tested in the longitudinal direction (direction of maximum strength) using 3-point bending with a span length of 2.5 inches. Tests were conducted at 8 temperatures from 20 C to 220 C. Creep tests were conducted for period of time ranging from a few hours to a few days. The Larson-Miller parameter method shows some promise for predicting long term creep behavior of PEEK-graphite fiber composite material. Creep failure occurs suddenly after very small creep deformations of only 0.01-0.04 percent at high temperatures and is, therefore, quite insidious in nature since imminent failure is most difficult to detect. Author (CISTI)

N93-20645# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.

TWO-D TO THREE-D GLOBAL/LOCAL FINITE ELEMENT ANALYSIS OF SYMMETRIC FINITE COMPOSITE LAMINATES WITH HOLES

D. Muheim Thompson and O. Hayden Griffiin, Jr. *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 200-201 (For primary document see N93-20616 07-39)

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This paper discusses the development verification of a computationally efficient analysis technique, the global/local finite element method, as applied to finite laminated composites. The method is the zoom technique, where an analysis is performed, the results from a certain region taken as accurate, and applied as boundary conditions to a more refined analysis of a part of the original problem. This zooming can be done successively, if required, to obtain very detailed results for a small portion of the complete problem. The approach taken here is a two dimensional local analysis. Global/local finite element analysis was applied to a thin composite laminate with a central circular hole subjected to in-plane compression loading. Significant reductions in the computer resources required were realized while maintaining the same degree of accuracy as the full three dimensional model. Comparison of the stress fields for the global/local analysis procedure and a complete three dimensional model were completed and proved that the proper application of such a technique can make unmanageable problems tractable. The influence of different diameter holes in a finite width plate on the straight free edge and around the hole itself were examined for a cross-ply and a balanced stacking sequence. Several different symmetric lamination orientations for the hole diameter were also studied. The large number of cases considered demonstrates that this method is general and applicable to modelling the structural response of composite laminates. Author (CISTI)

N93-20646# Missouri Univ., Rolla. Dept. of Mechanical and Aerospace Engineering and Engineering.

LARGE AMPLITUDE FREE VIBRATIONS OF CROSS-PLY COMPOSITE BEAMS

Kiran M. Bangera and K. Chandrashekhara *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 202-203 (For primary document see N93-20616 07-39)

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A finite element method is developed to study the large amplitude free vibrations of cross-ply laminated composite beams. The large deformations are incorporated in the formulation using a von Karman type strain displacement relation. The transverse shear flexibility is included using a higher order shear deformation theory which accounts for the parabolic variation of the transverse shear strain. The direct iteration method is used to solve the nonlinear equations which are evaluated at the point of reversal of motion. The influence of boundary conditions, beam geometries and ply orientations on the nonlinear frequencies and mode shapes are demonstrated. Author (CISTI)

N93-20647# Bristol Aerospace Ltd., Winnipeg (Manitoba).

PROBABILISTIC DESIGN PROCEDURES FOR LOAD BEARING CERAMIC COMPONENTS

J. Margetson *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 204-205 (For primary document see N93-20616 07-39)

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Probabilistic design procedures are presented for predicting the failure probability of load bearing ceramic components. These statistical techniques make use of modified Weibull distributions and are applicable to components subjected to conditions of multiaxial stress. An analytical technique is described for evaluating the defect distributions from flexural strength test data. The structural reliability of a ceramic lined fiber reinforced rocket motor blast pipe is evaluated to illustrate the use of the various probabilistic design procedures. An identical approach can be used for the surface defect failure analysis. Author (CISTI)

N93-20648# Chung Shan Inst. of Science and Technology, Taichung (Taiwan).

ON THE VIBRATION OF THERMALLY STRESSED LAMINATED COMPOSITE CYLINDRICAL SHELLS

Sheau-Fan Ma and M. C. Wilcox (Southern Methodist Univ., Dallas, TX.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 206-207 (For primary document see N93-20616 07-39)

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An analytical formulation is treated for determining the free vibrational characteristics of heated, laminated composite shells. The general forms of equations of motion for cylindrical shells are developed from an energy approach with certain practical cases of laminates which are uniformly heated and free from externally applied loads. Approximate solutions are obtained by employing Galerkin's method in conjunction with proper geometric boundary conditions and applied temperature functions to arrive at a frequency equation. The dynamic response of heated, laminated cylindrical shells is made to investigate the influences of temperature

functions, lamination angles, number of layers, stacking sequence, and geometric aspect ratios on the reduction of the effective stiffness and frequencies of shells. Numerical results confirm the expectation that the frequencies decrease with increasing temperature, even though this increase is not at a level to cause deterioration of the mechanical properties of the composite materials. Author (CISTI)

N93-20649# Ottawa Univ. (Ontario). Dept. of Mechanical Engineering.
A SUPERPOSITION-RAYLEIGH RITZ METHOD FOR FREE VIBRATION ANALYSIS OF NONUNIFORMLY STRETCHED RECTANGULAR MEMBRANES
D. J. Gorman and R. K. Singal (Canadian Space Agency, Ottawa, Ontario.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 212-213 (For primary document see N93-20616 07-39)
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The focus of this work is on the large membrane radar arrays and solar arrays of the envisaged space based radar spacecraft. Since they are extremely light weight structures, they present very demanding analytical and test requirements. Further, because a radar array is an active system, the performance of a radar system can be seriously affected by the structural characteristics of the array. The objective of the work is to develop theoretical capabilities using continuum mechanics methods to perform free vibration analysis (for frequencies and mode shapes) of rectangular membranes with various types of irregular edge loadings. In this paper, as a first step in looking at the overall problem, attention is focused on a single cell only. The problem of a rectangular membrane subjected to equal, concentrated (tensile) loads at the four corners is considered. First, an analytical solution for the initial stress distribution in the membrane is obtained. Second, a solution method is developed for computing the free vibration frequencies and mode shapes of the membrane tensioned as described above. In initial verification tests the superposition Rayleigh Ritz method was used to analyze the free vibration of a membrane with uniform loading along two opposite edges, lateral displacement being forbidden along the loaded edges, the other edges being free. For this particular simplified problem the solution is readily attainable by exact analytical means. Very good agreement has been encountered between eigenvalues obtained by the new general method described and the exact analytical results. This provides a high degree of confidence in the reliability of the analysis. The current method, unlike the classical analytical method, is not limited to the analysis of the membrane problems with uniform edge loading. Author (CISTI)

N93-20650# Alabama Univ., Tuscaloosa.
NUMERICAL STABILITIES ASPECTS OF CABLE DYNAMICS SIMULATION
Guey-Shin Chang and Howard Wilson *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 220-221 (For primary document see N93-20616 07-39)
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The dynamical behavior of cable systems has practical interest in diverse applications ranging from marine towing of sonar devices to tether systems employed in spacecraft, and has been studied extensively. A study is presented of the difficulties commonly encountered in the numerical solution of differential equations developed in analysis of such systems. It is argued that the highly nonlinear dynamics of the cable system leads to numerical inaccuracies which grow exponentially with time, if the local stability matrix has eigenvalues with relatively large positive real parts. A two dimensional multiple degree of freedom cable modeled by a chain of rigid links and constrained at both ends is used to analyze the problem. A method of determining the Jacobian stability matrix for a constrained system is developed. The numerical results are obtained using a typical variable step seventh and eighth order integrator based on formulae of Fehlberg and the MATLAM computer program. Author (CISTI)

N93-20651# Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
AN EFFICIENT METHOD FOR THE RELIABILITY ANALYSIS OF GEOMETRIC NONLINEAR FRAME STRUCTURES
Achintya Haldar and Yiguang Zhou *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 226-227 (For primary document see N93-20616 07-39)
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Until very recently, most of the development in the area of the stochastic finite element method (SFEM) was limited to the study of linear structures. For a class of structural engineering problems with large geometric deformation, the approximate results obtained by linear analysis techniques must be employed. In order to carry out reliability analysis of such complicated nonlinear problems, the SFEM can be used. Algorithms currently available are not efficient and are limited to the study of simple problems. The assumed stress field finite element method based on the complementary energy has several desirable features in efficiently solving nonlinear problems. An efficient SFEM based on the reliability approach is proposed in this paper to solve the structural reliability problems involving geometric nonlinearity. The assumed stress field method is used in computing the structural response gradients. In this approach, not only can the nonlinear stiffness matrix of a structure be expressed in explicit form, but all the gradients about the basic random variables needed in the computation of the reliability can also be expressed in the explicit forms. These features make the proposed algorithm more economical and efficient.
Author (CISTI)

N93-20652# Pulsert Consolidated Technology Ltd., Calgary (Alberta).
MULTIMODAL OPTIMIZATION OF VIBRATING SPACE FRAMES
J. A. Czyz and S. A. Lukasiewicz (Calgary Univ., Alberta.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 228-229 (For primary document see N93-20616 07-39)
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Application of optimal shape methods developed for truss or frame structures to three dimensional multimodal optimization has not been fully successful. This paper presents the optimization technique giving two sizes of the cross-section of the elements. A vibrating space frame composed of beam elements of rectangular cross-sections is the subject of the present analysis. The goal of the optimization is to maximize the natural frequency of the frame with the condition that the volume of the frame is constant. A method of multimodal optimization of three dimensional frames for maximum natural frequency with constant volume constraint is employed. Optimization variables are two dimensions of rectangular cross-sections of each beam elements. The optimality criterion is formulated using specific energies associated with each principal axis of beam element cross-section. Author (CISTI)

N93-20653# Waterloo Univ. (Ontario). Dept. of Civil Engineering.
DELAMINATION BUCKLING IN CIRCULAR PLATES
Jay K. Pierson and J. Roorda *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 232-233 (For primary document see N93-20616 07-39)
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A proper assessment of the useful life of components made from laminated materials requires a thorough understanding of the possible failure modes and mechanisms caused by delaminations. Formation of sufficient energy at the crack front to cause gradual or catastrophic growth of the delamination area leading to premature failure. In this paper, the phenomenon of delamination buckling and growth in a compressively loaded laminated circular plate is analyzed. Earlier studies of this problem limited the location of the delamination to near the surface and to the midplane of the laminated plate. The work presented takes a more generalized approach allowing for other possibilities. Using a numerical integration technique, solutions for the critical buckling load and post buckling deflections are obtained for clamped conditions. The post buckling solution is used to determine the energy release rate associated with delamination growth. Critical buckling loads and stability characteristics of delamination growth are shown to be dependent on delamination size and location. Under certain conditions of geometry, bonding strength and loading, delamination growth is highly probable and may proceed catastrophically. Author (CISTI)

N93-20654# Indian Inst. of Tech., Kanpur. Dept. of Civil Engineering.
BUCKLING OF CLAMPED ANGLE-PLY LAMINATED PLATES UNDER INPLANE LOADS
Vivek Saxena and Ashwini Kumar *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991

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The present investigation deals with the buckling of angle-ply laminated plates under in-plane loads. The formulation is based on classical thin lamination theory and the Rayleigh Ritz energy method is used to find the buckling load. For the purpose of the formulation, no specific boundary conditions are specified, except that the plate is assumed to be supported along the edges. The results, however, are presented for clamped boundary conditions only. The approximating functions, which should satisfy the geometric boundary conditions, are assumed for the buckled shape of the plate. The substitution of these functions in total potential energy and subsequent minimization results in a system of homogenous equations. These equations contain stiffness and load terms plus unknown coefficients of approximating functions. The system of equations is carefully separated for symmetric and antisymmetric modes of buckling and the lowest eigenvalue is found for each group. A computer program has been developed for evaluating the elements of the matrices developed from the equations and eventually solving for the lowest eigen. For the sake of illustration, a carbon-epoxy angle-ply plate is analyzed. Results are presented for uniaxial compression, positive and negative shear, and combined compression and shear. Author (CISTI)

N93-20655# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
PREDICTING THE FAILURE LOAD OF ADHESIVE JOINTS
J. K. Spelt and G. Fernlund *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 238 (For primary document see N93-20616 07-39)
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The engineering design of structural adhesive joints is complicated in general by the complexity of the stress distribution in the adhesive, and the lack of failure criterion. A possible approach to this analysis is to apply beam theory to generic adhesive sandwiches isolated as free-bodies from a surrounding structure. The response of the joint can then be expressed as a function of the reactions (tension, bending, shear) action on the free-body, one side of which is the end of the joint overlap or crack tip. This paper presents an analytical approach to the calculation of the strain energy release rate for arbitrarily loaded adhesive sandwich elements. Beam theory is used to determine the reactions on either side of the end of the joint overlap or crack tip. A relatively simple analytical method is then given to calculate the strain energy release rate and the mode ratio. The present approach is more general than the traditional compliance method because it can be used for arbitrary loading conditions and nonlinear beam behavior. Author (CISTI)

N93-20656# Northeastern Univ., Boston, MA. Dept. of Mechanical Engineering.
PEAK STRESSES IN ADHESIVE STEP LAP JOINTS WITH VOIDS
J. N. Rossettos and E. Zang *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 242-243 (For primary document see N93-20616 07-39)
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In composite to metal joining applications, such as in aerospace and high technology structural components, adhesive bonded joints are finding increased use because of their many advantages in terms of strength to weight ratio, stress distribution, design flexibility, cost reduction and simplicity of fabrication. It is known however, that defects in the adhesive can severely reduce the bond strength. The presence of voids or disbond type flaws in the adhesive will increase the peak stress levels which occur at the joint ends and near the flaw itself. In the present work, the stresses in a step lap joint with a void are shown to depend on certain governing parameters which completely characterize the problem. Based on appropriate equilibrium, stress-strain (plane strain) and strain displacement relations, the problem is reduced to a second order differential equation for the axial load in one of the adherends. A convenient non dimensionalization of quantities in the equations leads to three parameters which uniquely define the stress distribution in the joint. In this sense, the curves obtained for the non dimensional stresses are universal and parameter dependent, and therefore, very useful for design or testing purposes. Author (CISTI)

N93-20657# Alberta Univ., Edmonton. Dept. of Mechanical Engineering.
A METHOD OF CONTINUOUS COORDINATE CONDENSATION **c64**
W. F. Eckert and A. Craggs *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 244-245 (For primary document see N93-20616 07-39)
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This paper introduces a new method of continuous coordinate condensation to reduce the matrix size. The eigenvalues of a dynamic problem may be found by examining the forced harmonic response of a reduced mathematical model. As each element is assembled into the global matrices, the intermediate nodal unknowns are condensed out of the system. As a result, only the input and output nodes are retained, limiting the degrees of freedom of the matrices to that of a single element of the model. However, the resulting superelement retains all the dynamic characteristics of the full finite element model. The method is performed iteratively for discrete forcing frequencies over the range of interest, and the resulting response to the input function clearly indicates the natural frequencies or critical speeds as well as giving an accurate estimate of the off resonant response. Both of these parameters are important in system identification. Author (CISTI)

N93-20658# British Columbia Univ., Vancouver. Dept. of Mechanical Engineering.
ANALYSIS OF STRUCTURALLY-VARYING SYSTEMS USING COMPONENT-MODE SYNTHESIS TECHNIQUE **c61**
Jie Peng and Clarence W. deSilva *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 246-247 (For primary document see N93-20616 07-39)
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Component-mode synthesis (CMS) is a modelling technique originally developed for dynamic analysis and design of large complex structures. A considerable amount of literature is available on the CMS technique, but they have exclusively considered systems with time-invariant constraints, due to the fact that the techniques were originally developed for the modal analysis of large systems with time invariant structures. The application of the technique in the analysis of a class of dynamical system which has a time-varying structure was investigated. The CMS technique was extended to a modelling of a dynamic system with time-varying structure. A recursive algorithm for real-time updating of the system model has been developed. The main advantage of this algorithm is that it is based on modal analysis of the subsystems, which can be done off-line beforehand. The decoupling of the overall system and stability analysis of the overall system will be two of the major areas of future research. Author (CISTI)

N93-20659# Colorado School of Mines, Golden. Dept. of Engineering.
INSTABILITY AND VARIATION ANALYSIS USING A PARALLEL SUBSTRUCTURING PROCEDURE **c62**
H. P. Huttelmaier *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 248-249 (For primary document see N93-20616 07-39)
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Subspace iteration techniques are among the most popular solvers for eigenvalues encountered in finite element analysis of buckling and free vibration problems. Substructuring techniques are not always considered efficient in a traditional computing environment but may be effective in a parallel processing environment. In this study the component mode synthesis was applied using a shared memory processing system. The parallel algorithm applied consists of four major computational steps: (1) domain discretization, (2) solution of the local subdomain eigenvalue problem using a subspace iteration technique, (3) assembly of substructure matrices, and (4) solution of the global system using a subspace iteration routine. The algorithm was tested for plate vibration and buckling problems where the number of substructures and the number of processors were major parameters. The speedup reached a maximum when the number of substructures coincided with the number of processors. After this point the speedup ratio did not improve and in some cases it deteriorated slightly. A similar behavior was observed when the number of substructures was increased. Author (CISTI)

N93-20660# Texas Univ., El Paso. Dept. of Mechanical and Industrial Engineering.
FREE VIBRATIONS OF A FLEXIBLE TAPERED ARM ATTACHED TO A COMPLIANT HUB
W. Lionel Craver, Jr. and Armando H. Carrasco *In* Manitoba Univ.,

Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 250-251 (For primary document see N93-20616 07-39)
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A single link flexible robot arm can be modeled as a Bernoulli Euler beam to describe its dynamic behavior. The first six natural frequencies for a flexible uniform beam attached to a compliant hub undergoing free vibration have previously been presented. This article extends the work to that of a linearly tapered robot arm. The equations of motion are presented and the characteristic determinant is derived. The determinant is then solved for the first five natural frequencies of the system. Author (CISTI)

N93-20661# Cornell Univ., Ithaca, NY. Sibley School of Mechanical and Aerospace Engineering.
PEANO-LIKE DYNAMICS AS A MODEL FOR STRANGE NONCHAOTIC BEHAVIOUR c64
M. S. ElNaschie *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 254-255 (For primary document see N93-20616 07-39)
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Recent investigations have revealed the existence of strange, nonchaotic attractors in quasi periodically driven oscillators. These are fractal attractors which look topologically strange, yet possess negative Liapunov exponents. Also, recently convincing reasons have been put forward for anticipating new strange chaotic phenomena in four dimensions. A scenario which is similar to a Smale horse shoe and may serve as a prototype for strange, but nonchaotic behavior is outlined. It is shown that the action of contracting, stretching and special form of twist folding of the phase space in a shoe leads to a distinct form of dynamics. The invariant set of these dynamics are Cantor-like objects and may be shown to be oriented on a Peano curve-like discrete manifold. The immediate consequence of this picture is that it may be anticipated that the Poincare map of such a system with strange nonchaotic behavior will have a fractal dimension, the limit of d(sub c) approximately equal to 2. Author (CISTI)

N93-20662# Windsor Univ. (Ontario). Dept. of Mechanical Engineering.
RESONANT RESPONSE ANALYSIS OF A HIGH SPEED GEAR c37
Jean Lee *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 268-269 (For primary document see N93-20616 07-39)
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The resonant response of high-speed, lightweight and highly loaded gears may cause rapid and destructive failure. The resonant response of a transmission gear in a jet engine experiencing resonant failure was investigated. It is a 97-tooth planet gear in a planetary gear train. Its operating range is from 7800 to 10,000 rpm. The finite element method was used to evaluate the resonance behavior of the gear. Experimental work was subsequently conducted to confirm the mode shapes and the level of response. A resonance analysis was also carried out to identify the resonant frequencies when the gear is rotating. It was found that that the finite element method accurately predicted the natural frequencies of the complex gear shape. The results of this work were used to modify the gear design so that its natural frequencies do not coincide with any operational excitation condition. Author (CISTI)

N93-20663# Victoria Univ. (British Columbia). Dept. of Mechanical Engineering.
THERMALLY INDUCED VIBRATIONS IN A TEMPERATURE-RATE DEPENDENT THERMOELASTIC SOLID WITH A SPHERICAL CAVITY
H. A. Erbay, S. Erbay, and S. Dost *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 270-271 (For primary document see N93-20616 07-39)
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In the present work thermally induced vibrations in an infinite solid with a spherical cavity is examined, assuming the medium is a linear, isotropic, temperature - rate dependent thermoelastic solid. The surface of the cavity is assumed to be subjected to a temperature varying harmonically with time, and free of stresses. The goal here is to examine the significance of inclusion of the second sound effects into the theory for this problem. For the analysis the generalized theory of thermo elasticity introduced by Green and Lindsay, and Suhubi was adopted. The basic equations and the associated boundary conditions are given in non dimensionalized forms, and then the decoupled field equations for the radial displacement and the temperature change are obtained. The field equations admit exact solutions, which are functions of the spherical Hankel functions. It can be shown that the results of the present work reduce those obtained by other investigators as particular cases. Author (CISTI)

N93-20664# McMaster Univ., Hamilton (Ontario). Dept. of Mechanical Engineering.
ELIMINATION OF RESONANCE WITH A SWITCHING SUPPORT
T. P. Turkstra and S. E. Semercigil *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 272-273 (For primary document see N93-20616 07-39)
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An add-on switching support is proposed to limit the vibration of a transmission shaft. Experiments are described achieving amplitude reductions in the order of 75 percent. A simple active on/off control system to restrain the excessive transient vibrations of flexible shafts has been designed. The control can be implemented as an add-on system without interfering with the existing bearing structure. An advantage of such an add-on system is that it can be used in already existing structures which operate at supercritical speeds. A finite element analysis (FEA) technique has been utilized to simulate the dynamic response of the flexible shaft operating at sub and supercritical speeds. The results suggest that a vibration amplitude reduction of 75 percent could be obtained with the actuation of the intelligently switching extra support, which could be referred to as a switching support or a phantom support. Experimental data back up the numerical results, demonstrating the viability of the switching support technique for limiting vibration amplitude. At the motor, an amplitude reduction of 75 percent was achieved with the switching support over the simply supported case. An 80 percent reduction over the triply supported case was achieved. Thus the switching support can be used to instantaneously modify the shaft stiffness and the resonant frequencies so that the excitation speed can never approach a resonant frequency.
Author (CISTI)

N93-20665# Technical Univ. of Istanbul (Turkey).
DAMPED VIBRATION OF ENGINE VALVE TRAIN BY RECENT TRANSFER MATRIX AND MATRIX PROCEDURES
Vedat Karadag *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 274-275 (For primary document see N93-20616 07-39)
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Damped vibrations of engine valve systems have been investigated by multiple degree of freedom models and the recent transfer matrix techniques and complex eigenvalue analysis procedures. The numerical results obtained were compared with the other available procedures including an exact continuous model solution. The multiple degree of freedom models were found to be superior, especially, in predicting forces acting on the engine valve train. The present application of the transfer matrix method with recent developments, gives accurate estimation of the vibration characteristics and harmonic response of engine valve trains. Complex matrix method analysis also supports the obtained results. Author (CISTI)

N93-20666# Laval Univ. (Quebec). Dept. of Mechanical Engineering.
DYNAMIC SIMULATION OF FLEXIBLE BODY SYSTEMS BY THE VECTOR SOLUTION METHOD [SIMULATION DYNAMIQUE DES SYSTEMES DE CORPS FLEXIBLES PAR LA METHODE DU RESEAU VECTORIEL]
Tennich Mohamed and Marc J. Richard *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 276-277 In FRENCH (For primary document see N93-20616 07-39)
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In the present work an analysis of vibration of a flexible beam with a continuous distribution of mass and rigidity was undertaken. This study was limited to uni directionally flexible bodies, such as straight beams with uniform or variable sections, and is based on the Bernoulli equations for transverse vibration of beams without structural damping. The solution to the Bernoulli equation is formulated by a product of a deflection term, X(x) and a temporal term T(t) given by the Duhamel integral. The dynamics of a solid in three dimensional space is represented by the Euler equations. A mathematical model based on the vector network method is presented. A study of the effect of landing impact and of roughness of the landing strip on vibrations in the wings of aircraft was undertaken using the model.

For large aircraft the dynamic loads induced by landing impact are important factors in fatigue damage to the aircraft. This study demonstrated the potential for vector network methods in the simulation of the dynamics and vibration of mechanical systems composed of rigid and flexible members. The study showed the presence of large induced vibrations in the wings as a result of landing impact and of the surface roughness of the landing strip. Author (CISTI)

N93-20667# California State Univ., Long Beach. Dept. of Mechanical Engineering.

GREEN'S FUNCTION METHOD FOR VIBRATION OF STRUCTURES

c64

H. V. Vu and J. C. Cule (Northrop Corp., Pico Rivera, CA.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 280-281 (For primary document see N93-20616 07-39)

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Vibration of flexible structures with dynamic vibration absorbers attached is of considerable interest to structural control. Green's function is particularly useful for solving vibrations of structures with absorbers attached. This approach has been ignored by or is unfamiliar to a large number of people in the vibration community. In this paper, vibration analysis of a cantilever beam with a vibration absorber attached arbitrarily along the beam using Green's function is presented and easy to follow details are given. The advantage of using Green's function is that a closed form solution can be obtained. Green's function method can be used to solve vibration problems of frames consisting of beams as components.

Author (CISTI)

N93-20668# Carleton Univ., Ottawa (Ontario). Dept. of Mechanical and Aerospace Engineering.

FORCED VIBRATION OF NON-SELFADJOINT ELASTIC SYSTEMS

F. F. Afagh and X. Li *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 284-285 (For primary document see N93-20616 07-39)

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Forced vibration of a spatially one dimensional elastic system under mechanically nonconservative follower forces is considered. Such a system results in mathematically non-selfadjoint problems. While the present formulation can be generalized to include two dimensional problems such as plates, for the sake of simplicity this presentation deals with a spatially one dimensional system such as a rod. Theory and solution methodology are presented for the fundamental dynamic characteristics of a given system. These characteristics are meaningful only within the corresponding regularity domain of the system where the stability of the system prevails. For a clamped-free rod with uniformly distributed tangential follower forces, the regularity domain is bounded by the first critical load q which corresponds to the first flutter load of the rod and onset of instability of the system. Using the characteristic equation of the system, the eigenvalues of the system are obtained. The variation of the first two natural frequencies of the system with respect to the load parameter q is quite nonlinear. However, for higher frequencies due to weak nonlinearity of variation of the eigenvalue lambda, with respect to q, a linear interpolation would be satifactory. Finally, the response of the system to a driving force is available in a closed form solution. Author (CISTI)

N93-20669# Carleton Univ., Ottawa (Ontario). Dept. of Mechanical and Aerospace Engineering.

TRANSVERSE VIBRATIONS OF AN ELASTICALLY RESTRAINED ROD CARRYING A TIP MASS

F. Seddigh and F. Afagh *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 286-287 (For primary document see N93-20616 07-39)

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A large class of engineering problems in structural dynamics can be theoretically formulated by the Bernoulli Euler beam equation. A sub-class of these problems focuses on the vibrations of a beam with a tip mass. If the rod is subjected to an axial force and the ratio of the tip mass and beam mass is significant, the formulation of the problem becomes slightly different as the result of which in any vibrational analysis of the rod the question of the stability of the system should be addressed in a proper manner. This is in fact a complex form of the classical column problem. The present paper investigates the response of a tip mass subjected to horizontal distributed forces in cases when the tip of the column is elastically restrained against transverse motion by a set of springs. The mode frequencies and their coordinate function coefficients as well as the mode shapes are determined for an example system. Author (CISTI)

N93-20670# Calgary Univ. (Alberta). Dept. of Mechanical Engineering.

ON OSCILLATORY MOTION OF A SPRING-MASS SYSTEM SUBJECTED TO PIECEWISE CONSTANT FORCES

LiMing Dai and M. C. Singh *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 288-289 (For primary document see N93-20616 07-39)

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In this paper, the aim is to study the motion of a spring-mass system subject to a displacement related piecewise constant external force in the form of f(x(/t/)), where x(t) is an unknown function and x(/t/) assumes a constant value during the interval of time between two consecutive integer points of t. Unlike the classical equation of motion for linear vibration in which the external forcing function f(t) is known, the governing equation here involves a forcing function f(x(/t/)) which is discontinuous and unknown till the complete solution of x(t) is obtained. Initial value problems of damped and undamped one dimensional spring-mass systems subjected to the piecewise constant forces are discussed in detail. Complete solutions of the problems are derived with motions totally different from those of the classical linear vibrations, and oscillatory or asymptotic properties of the motions are analyzed both theoretically and numerically. Author (CISTI)

N93-20671# Liege Univ. (Belgium).

DYNAMIC ANALYSIS OF A VARIABLE-MASS MULTIBODY SYSTEM

John J. McPhee and Rajendra N. Dubey (Waterloo Univ., Ontario.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 292-293 (For primary document see N93-20616 07-39)

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A formulation of the equations of motion for variable mass, multibody system is presented. Based on this formulation, a computer program was developed to numerically simulate the motion of a given mechanical system. Captured or released material is modelled as a finite number of particle masses which can be entering or leaving the system at any number of locations. As demonstrated by an example, a continuous mass transfer process can be simulated quite accurately by increasing the number and decreasing the size of these particles. With this unique modelling procedure, the program is capable of analyzing systems undergoing quite general mass capture or release processes. The range of physical systems which can be analyzed by the program is limited to those with a specific topology. Author (CISTI)

N93-20672# British Columbia Univ., Vancouver. Dept. of Mechanical Engineering.

VIBRATION OF A MULTI-GUIDED ROTATING STRING

Y. Xiong, S. G. Hutton, and L. Yang *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 294-295 (For primary document see N93-20616 07-39)

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The vibration of translating and rotating strings represents many practical problems with axial motion or rotation. A rotating string with point and distributed springs is taken as the problem of study in this paper because this model includes the translating string and the rotating string as its special cases. The governing equations and boundary conditions are derived by using Hamilton's principle and analytical solutions are obtained. In order to examine the application of Rayleigh Ritz method to this kind of problem, an approximate formulation with trigonometric shape function is constructed. Numerical results are presented, illustrating the effectiveness of Rayleigh Ritz formulation employed and showing some interesting features of the system under consideration. This simple model provides insights into the vibration characteristics of more complex rotating and translating systems. An exact analysis has been performed and an approximate formulation by Rayleigh Ritz method constructed. Numerical results show that the Rayleigh Ritz method is effective for approximate calculations of the problems under consideration. Author (CISTI)

N93-20673# Korea World Trade Centre, Seoul.
THE FREE VIBRATION OF ISOTROPIC AND SPECIALLY ORTHOTROPIC TRIANGULAR PLATES
C. S. Kim *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 316-317 (For primary document see N93-20616 07-39)
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A relatively simple Rayleigh Ritz solution, with simple polynomials as the admissible functions, was given for the free vibration analysis of thin, isotropic and orthotropic, right triangular plates. Numerical results were obtained for plates of various aspect ratios and having all combinations of the classical free, simply supported and clamped boundary conditions. In the present paper, the method is extended to apply to plates of general triangular planform. The analysis remains relatively simple and the computational work remains less than that required when using the methods described in most eariler studies, whilst the accuracy is comparable. Sample studies illustrating the convergence of the solution are given and comparison with results available from the literature show the validity of the approach. Natural frequency parameters and nodal patterns have been determined for a fairly comprehensive selection of particular plates, a few of these results being reported here. Author (CISTI)

N93-20674# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
STUDY OF FREE VIBRATION OF ORTHOTROPIC RECTANGULAR PLATES
S. D. Yu and W. L. Cleghorn *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 318-319 (For primary document see N93-20616 07-39)
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Analytical solutions for free vibration analyses of orthotropic rectangular plates with classical boundary conditions are developed using the method of superposition. Mathematically, there are eighty-one combinations of classical boundary conditions for an orthotropic rectangular plate. The analytical solution for a plate involving simply supported edges may be easily obtained from that for a plate whose corresponding edges are fully clamped. The remaining edges for the two plates are subject to the same boundary conditions. Considering this important fact, only six cases of supports need to be investigated. They are: clamped - clamped - clamped - clamped; free - clamped - clamped - clamped; free - free - clamped - clamped; free - clamped - free - clamped; free - free - free - clamped; and free - free - free - free. Plates with four edges simply supported are excluded because solutions are analytically available. A solution for a plate with combinations of clamped and free edges may be obtained by superimposing solutions for the four building blocks. A Levy type solution for each building block is available. The exact solution is then obtained by requiring boundary conditions along the four edges to be satisfied. Only results are presented. Author (CISTI)

N93-20675# Indian Inst. of Tech., Kharagpur. Dept. of Aerospace Engineering.
BUCKLING AND DYNAMIC INSTABILITY PHENOMENA OF TAPERED BAR WITH LOCALIZED FLAW SUBJECTED TO AN INTERMEDIATE PERIODIC AXIAL LOAD
P. K. Datta *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 328-329 (For primary document see N93-20616 07-39)
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Advanced alloys and composites having a high strength to weight ratio are vulnerable to damage, particularly in the presence of flaws during the manufacturing process. A finite element approach is employed to study the effects of localized flaw on the buckling and parametric instability behavior of a non-prismatic bar subjected to an intermediate periodic axial load. The effect of a region of damage is introduced by the use of an idealized model having a reduction in the elastic property at the zone of damage. The effect of increase of the extent of damage is to reduce the static buckling load of the beam substantially. There is a critical position of damage on the beam fore and aft of which the variation of the buckling load is increasing as the damage moves near the ends. The critical position of damage on the beam shifts as the intermediate concentrated load moves and in the same direction. The effect of increase of the extent of damage is to reduce the natural frequency of the beam substantially. There is a critical position of damage on the beam fore and aft of which the frequency increases as the damage moves near the ends. The effect of increase of the extent of damage on parametric instability causes the appearance of instability regions at higher disturbing frequency. Both position of damage and position of intermediate load have a significant effect on the dynamic instability behavior. Increase of the static load factor moves the instability zones inward on the frequency ratio axis and widens them resulting in instabilities at lower frequencies. Author (CISTI)

N93-20676# Nanyang Technological Inst. (Singapore).
SEMI-NUMERICAL APPROACH TO THE BUCKLING OF COMPOSITE PANEL
P. W. Khong *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 334-335 (For primary document see N93-20616 07-39)
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Buckling analysis of composite materials is tedious and expensive, especially when various edge boundary and loading conditions are included. A finite strip method implemented on the buckling analysis of laminated composite panels is presented. In the analysis, the out of plane behavior of the composite panel is described by thin plate theory and the deformation variations across the panel are represented by a fifth degree polynomial function. Elementary beam theory is used to account for the in-plane destabilizing effects. Employing the Rayleigh Ritz method, stiffness matrices are formed through minimizing the total potential energy with respect to the displacement parameters. The algorithm is simple and direct. Regardless of the number of layers of laminate and the complexity of the arrangement, it eventually leads to 7 by 7 stiffness matrices being formed. Since the matrices derived are small in scale, they do not require a large memory space when programmed on a computer. The routine is ideal for parametric study of laminated composite panels. Author (CISTI)

N93-20677# British Columbia Univ., Vancouver. Dept. of Mechanical Engineering.
FRACTURE TOUGHNESS USING CIRCULAR DISCS
Henry Vaughan and Qiong Wu *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 344-345 (For primary document see N93-20616 07-39)
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A general solution is presented for a circular disc containing a radial crack. The perimeter of the disc is loaded quite generally by a set of self equilibrating surface tractions, subject to the requirement that they open the crack along its entire length. Two particular solutions are presented in detail: (1) the plate under diametrical concentrated forces; and (2) the plate with concentrated forces applied at the mouth of the crack. It is shown how cases (1) and (2) may be used in controlled tests for determining fracture toughness. Finally, a concentric hole is introduced at the crack tip to relieve the stress, and the effect of hole size on stress relief is examined. Author (CISTI)

N93-20678# Naval Research Lab., Washington, DC. Mechanics of Materials Branch.
PREDICTION OF FRACTURE INITIATION IN SURFACE FLAWS
V. Gensheimer DeGiorgi *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 348-349 (For primary document see N93-20616 07-39)
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Many naturally occurring cracks are three dimensional and cannot be evaluated using numerical techniques derived using two dimensional simplifications. The high stress and strain levels which are experienced in high toughness alloys prior to fracture require a means to accurately simulate the nonlinear material response regime. An accurate constitutive representation must be combined with a fracture criterion which is valid for the high strain regime in order to achieve accurate numerical simulations. Therefore, material modeling, material parameter identification, and fracture criterion are issues which must be addressed for the three dimensional evaluation of surface cracks. Nonlinear numerical simulations were performed to determine the global and local response of two surface cracks of differing depths due to either tension or bending across the thickness. The surface cracks were embedded in HY-100 structural steel, a high ductility and toughness metal. The crack geometry and crack depth studied were considered to be representative of surface cracks of moderate depth. Continuum material response and local fracture criterion were used in the

numerical simulation. The variation in constraint along the curved back perimeter is explicitly included in the failure criteria by considering stress-strain history dependence of the critical strain energy density. The resulting fracture initiation and crack growth patterns accurately predict trends observed experimentally. Author (CISTI)

N93-20679# National Inst. of Standards and Technology, Boulder, CO.
EXPERIMENT AND MODELING OF AIR-COUPLED ULTRASONIC EXCITATION OF PLATE WAVES **c71**
C. M. Fortunko, M. C. Renken, R. L. Bratton (Colorado Univ., Boulder.), and S. K. Datta (Colorado Univ., Boulder.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 364-365 (For primary document see N93-20616 07-39)
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Currently, ultrasonic nondestructive evaluation (NDE) techniques employing Lamb waves require intimate coupling of transducers using liquid contact or direct mechanical contact. In the case of water immersion, which appears to be the prevalent choice, the speed of sound is approximately 1500 m/s. Therefore, no phase velocities below 1500 m/s can be physically measured using water as the couplant. To overcome this restriction the possibility of using air-coupled ultrasound was studied. The air-coupled technique can excite the lowest order flexural and longitudinal Lamb modes in the frequency region below the cutoff frequency in plates whose flexural and longitudinal phase velocities are lower than the speed of sound in the water couplant. Excitation of these two modes at the lower frequencies using air-coupled ultrasound is possible, because of the lower speed of sound in air, approximately 330 m/s. In this low frequency region, the two lowest modes are easily identifiable. In many cases, and particularly in the case of thin plates of materials exhibiting slow longitudinal and shear wave phase velocities, the speed of 1500 m/s exceeds the phase velocity of the two lowest-order guided waves and, hence, coupling cannot occur. Experimental measurements of the amplitude of transmitted, narrow-band, 0.5 MHz signals as a function of the angle of incidence are presented for plates of poly methyl methacrylate (PMMA). Air coupling can be used to study the propagation of elastic waves in PMMA plates and the experimental results have been found to be in agreement with plate-wave theory. Air-coupled ultrasound appears to offer the advantage of allowing coupling to the lowest flexural mode. However, the operating frequency must be low enough for this to occur.
Author (CISTI)

N93-20680# Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
NONDESTRUCTIVE EVALUATION OF SURFACE-BREAKING CRACKS IN COMPOSITE PLATES
W. M. Karunasena and A. H. Shah *In its* Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 380-381 (For primary document see N93-20616 07-39)
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Defects in structures made of composite materials have become a crucial problem. Rayleigh Lamb waves possess characteristics that make them particularly useful for applications in non destructive evaluation (NDE) of such defects in plate-like structures. In order to use Rayleigh Lamb waves in NDE applications, it is neccessary to investigate the phenomenon of scattering of these waves by defects. A hybrid method is presented for analyzing scattering of time harmonic guided plane strain (Rayleigh Lamb) waves by a crack in an infinite laminated composite plate. The hybrid method combines finite element formulation in a bounded interior region of the plate with a wave function expansion representation in the unbounded exterior region. The method is illustrated for the case of scattering by a symmetric surface breaking crack which is finite in the direction normal to the direction of wave propagation (x). Herein, (x, y, z) is a rectangular Cartesian coordinate system. A time harmonic plate strain wave excited at $x = +$ infinity, propagates in the negative x-direction and is incident upon the symmetric crack loaded at $x = 0$. After striking the crack, a scattered wave field will be generated. The two faces of the plate $z = 0$ and $z = 2H$, and the crack faces are traction free. Author (CISTI)

N93-20681# Carleton Univ., Ottawa (Ontario).
BATMAN-CRACKS. OBSERVATIONS AND NUMERICAL SIMULATIONS
A. P. S. Selvadurai, A. Ten Busschen (Technische Hogeschool, Delft, Netherlands.), and L. J. Ernst (Technische Hogeschool, Delft, Netherlands.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 382-383 (For primary document see N93-20616 07-39)
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To ensure mechanical strength of fiber reinforced plastics (FRP), good adhesion between fibers and the matrix is considered to be an essential requirement. An efficient test of fiber-matrix interface characterization is the fragmentation test which provides information about the interface slip mechanism. This test consists of the longitudinal loading of a single fiber which is embedded in a matrix specimen. At critical loads the fiber experiences fragmentation. This fragmentation will terminate depending upon the shear-slip strength of the fiber-matrix adhesion, which is inversely proportional to average fragment lengths. Depending upon interface strength characteristics either bond or slip matrix fracture can occur at the onset of fiber fracture. Certain particular features of matrix fracture are observed at the locations of fiber fracture in situations where there is sufficient interface bond strength. These refer to the development of fractures with a complex surface topography. The experimental procedure involved in the fragmentation tests is discussed and the boundary element technique to examine the development of multiple matrix fractures at the fiber fracture locations is examined. The mechanics of matrix fracture is examined. When bond integrity is maintained, a fiber fracture results in a matrix fracture. The matrix fracture topography in a fragmentation test is complex; however, simplified conoidal fracture patterns can be used to investigate the crack extension phenomena. Via a mixed-mode fracture criterion, the generation of a conoidal fracture pattern in the matrix is investigated. The numerical results compare favorably with observed experimental data derived from tests conducted on fragmentation test specimens consisting of a single glass fiber which is embedded in a polyester matrix. Author (CISTI)

N93-20682# Manitoba Univ., Winnipeg. Dept. of Applied Mathematics.
PERFORMANCES OF FINITE ELEMENT SOLUTION FOR CRACK PROBLEM
Benqi Guo *In its* Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 386-387 (For primary document see N93-20616 07-39)
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The elasticity problem on a cracked panel presents the most severe difficulties in computational structural mechanics because of the appearance of strong singularity of the solution around the tips. The crack problem is characterized as a boundary value problem. There are three approaches of the finite element method to computational mechanic problems: the h, p, and h-p version. The h version uses low-order polynomials and achieves the accuracy by reducing the size h of elements. The p version uses coarse mesh and increases the order of p polynomials to achieve the desired accuracy. The h-p version combines both, namely reduces the element size h and increases polynomial order to obtain the exponential rate of convergence even for the problems with strong singularity with respect to the number of degrees of freedom. It was found that numerical results coincide well with the theoretical asymptotic error analysis for the h, p, and h-p version at the practical engineering range of accuracy. The accuracy of the finite element solution of the h and p version is severely governed by the singularity of the solution and converges very slowly. It is very costly and even practically impossible for the h and p version to achieve high accuracy. The p version converges twice as fast as the h. The h-p version converges exponentially, and the desired high accuracy can only be achieved by the h-p version if the geometric mesh is properly designed. The linear distribution of polynomial order p can reduce substantially the number of degrees of freedom comparing with uniform distribution p. Author (CISTI)

N93-20683# Newcastle-upon-Tyne Univ. (England). Dept. of Mechanical, Materials and Manufacturing Engineering.
ANALYSIS OF MIXED MODE CRACKS IN A CYLINDRICAL SHELL
C. A. Smith and J. F. L. Chan *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 390-391 (For primary document see N93-20616 07-39)
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A new finite element procedure based upon point values of stress or displacement for calculating stress intensity factors (SIF's) for a crack in a cylindrical shell of radius or curvature R and thickness t is presented. A displacement extrapolation technique was selected for this work because it converges more rapidly, produces more accurate results and requires no

modification to the finite element codes employed. The procedure does not require special crack tip elements. The results obtained show that with careful consideration of the nodal displacements used, conventional elements can also produce accurate values of the SIF. The procedure takes into account the transverse shear deformation of a shell which is very important but often ignored in the analysis of crack problems in shells. The procedures are very easy to apply and can be expected to give good results, and are also applicable to a wide range of cases with different geometrical configurations. Author (CISTI)

N93-20684# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
MAIN CRACK-MICROVOID INTERACTION. THE ANTIPLANE PROBLEM
S. X. Gong and S. A. Meguid *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 392-393 (For primary document see N93-20616 07-39)
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The interaction of cracks with microdefects plays an important role in the mechanics and micromechanics of fracture in quasi-brittle materials. Increasing evidence suggests that microdefects such as microcracks, microvoids, inhomogeneities, and inclusions often control the overall failure mechanism of these solids. A general solution to the antiplane problem of the interaction between a semi-infinite main crack and an arbitrarily located and oriented microvoid (elliptical hole) is studied. The analysis is based on the superposition principle and the appropriate complex potentials for the antiplane problem. The solution to the problem is obtained by superimposing three subproblems, each of which contains either the main crack or the elliptical hole. The case of an arbitarily located and oriented elliptical hole near the tip of the crack main is considered. The present formulation predicts the dependence of the normalized stress intensity factor upon the location, orientation, and aspect ratio of the elliptical hole. Author (CISTI)

N93-20685# Tokyo Denki Univ. (Japan).
EXPERIMENTS ON THE IMPINGEMENT OF AN UNDEREXPANDED JET ON A FLAT PLATE
Junjiro Iwamoto, Hiroaki Ito, and Kuniyoshi Kikaru *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 454-455 (For primary document see N93-20616 07-39)
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The converging nozzle is often used as a device for transforming the pressure energy of the flow into velocity energy. When the ratio of the stagnation pressure to the static pressure of the flow through the converging nozzle is higher than the critical value (1.89 for air), then the flow velocity at the nozzle exit plane is almost sonic and is supersonic downstream of it. The flow under this condition is called underexpanded jet. It is known that when the flat plate is placed normal to the axis of the underexpanded jet, some interesting phenomena occur in the flow field near the plate. The experimental examination of the axisymmetric stagnation flow of the underexpanded jet near the flat plate is discussed. Flow was visualized using the shadow photography and Mach-Zehender interferometry and the pressure measurements are made on the flat plate. The density distribution for the flow field was determined from the interferograms. Pressure distributions were measured over the flat plate. The density distribution upstream and downstream of the standing shock and the position of the shock in the impinging jet were determined. Some evidence of reverse flow in the center of the jet between the shock and the plate is noted.
Author (CISTI)

N93-20686# Academy of Sciences (USSR), Novosibirsk.
ON THE DISTURBANCES DEVELOPMENT IN THE SUPERSONIC BOUNDARY LAYER **c02**
S. A. Gaponov *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 456-457 (For primary document see N93-20616 07-39)
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The stability of the supersonic boundary layer on a flat plate is studied both for parallel and nonparallel flows. The Dunn-Lin equations were used in the first case and a theoretical approach is applied for the second one. A comparison of experimental data from the literature with the theoretical predictions show close agreement for f = arctg(beta/real alpha(m)) is less than 70 deg (where beta is the wavenumber in the z direction and alpha(m) is the eigenvalue of the Dunn-Lin problem). Two reasons for the discrepancy at higher angles are offered: (1) the interaction of waves with close parameters in the nonparallel flow; and (2) nonlinear interaction of the waves. Author (CISTI)

N93-20687# Academy of Sciences (USSR), Novosibirsk.
STABILITY AND TRANSITION OF HYPERSONIC BOUNDARY LAYER **c02**
V. I. Lysenko *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 458-459 (For primary document see N93-20616 07-39)
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Peculiarities of laminar high-speed boundary layer stability and its transition to turbulence were studied experimentally and numerically. Boundary layer stability on a flat plate in the range of Mach numbers 11-16 was determined. In addition, flow around a rectangular obstacle was studied at a Mach number of 16 and around obstacles of various geometries at M(sub infinity) = 4. Finally, the influence of the ratio of specific heats on boundary layer stability and transition were investigated. The following observations were made: (1) the growth of the Mach number stabiiized the boundary layer; (2) increasing the height of a rectangular obstacle in the flow considerably increased the thickness of the disturbed layer and straightened the profile of the wake; (3) experiments carried out at M(sub infinity) = 4 showed that the growth of the entropy layer with increasing bluntness of the model destabilized both the disturbances in the entropy layer and the first mode disturbances in the boundary layer; (4) the frequency of disturbances leading to transition grew with decreasing specific heat of the gas; (5) gas dissociation led to a decrease in the transition Reynolds number; and (6) ionization of the flow led to a weak decrease in the transition Reynolds number on shock tube walls. Author (CISTI)

N93-20688# Manitoba Univ., Winnipeg. Dept. of Mechanical Engineering.
ON THE EVALUATION OF COHERENT STRUCTURES USING COMPUTER PROGRAMS **c61**
A. E. Tanjo and R. S. Azad *In its* Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 490-491 (For primary document see N93-20616 07-39)
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The existence of coherent structures in turbulent shear flows has been established by various investigations. Two methods have been used by investigators to evaluate statistical properties associated with the UV signal. Firstly, the mean period has been obtained using both digital and analogue circuits in which the frequency of events are estimated (hybrid method). Secondly, by computer programs evaluating the period of each event based on the leading front (digital method). When the distribution of any event in the record is not required, the hybrid method is easier and faster to program on computer. A computer program was developed, direct conditional analysis of Reynolds stress (DCARS), which can evaluate both methods simultaneously. The emphasis is on a hybrid method which compares with the digital method. The present modified frequency analysis compares well with other investigators. The fact that the goodness of fit extends to different positions show that the conditions proposed are not arbitrary. However, the choice of a finite duration for which periods of events are greater, is subject to individual standards especially in pipe flow where measurements cannot be made at Y(sup +) = 15 with standard x-wire probes. The present method has made it possible to explain the differences involved in evaluating the periods of coherent structures from frequency analysis and from the leading edge of the events.
Author (CISTI)

N93-20689# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
AN EXPERIMENTAL INVESTIGATION OF A ROUND TURBULENT JET IN A CROSS-FLOW **c34**
Z. Huang, J. G. Kawall, and J. F. Keffer *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 492-493 (For primary document see N93-20616 07-39)
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The behavior of a round turbulent jet in a cross flow is of considerable importance to the operation of very short takeoff and landing (VSTOL) aircraft. An experimental investigation of the turbulent jet flow that results when a circular jet is injected perpendicularly from an elevated source into a uniform, steady cross source is described. Mean and root mean square

velocity isocontours of the vertical center plane depicted the spread of the isothermal jet and its interaction with the cross flow and the wake behind the stack. Interactions below the center line of the jet involving the jet wake and the stack wake was wide and diffuse in comparison with the interaction region above the jet center line. Mean velocity isocontours provided the characteristics of the overall spread of a jet in a cross wind. Mean temperature isocontours for a heated jet in a cross wind provided a clear picture of the average shape of the jet since temperature acts as a tracer. A comparison of the isothermal contour plots obtained at various downstream locations establishes that the cross sectional shape of the jet evolves from a kidney shape in the near field to a roughly round shape in the far field. Autospectra of the temperature signals reveal that, in the lower region, a distinct frequency centered activity exists, there being a marked peak in the auto spectrum at a frequency of about 50 Hz. By contrast, no such activity exists in the upper region. Author (CISTI)

N93-20690# Windsor Univ. (Ontario). Civil and Environmental Engineering.

SPATIAL FORMULATION OF THE HEAT TRANSFER PROBLEM IN NONHOMOGENEOUS MEDIA **c34**

B. B. Budkowska and I. Kreja (Gdansk Technical Univ., Poland.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 530-531 (For primary document see N93-20616 07-39)

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An efficient algorithm for the analysis of transient problems of heat propagation in nonhomogeneous materials is presented. With respect to spatial variables the finite element method is applied with respect to time variables; the Euler backward finite integration method is used. The presented approach takes into account the variability of the material properties with respect to time and temperature. This is obtained through the introduction of temporal incremental decomposition of the material quantities as well as temperature variables. In order to improve the solution the Newton Raphson or modified Newton Raphson method is used at each time step. Some numerical examples are tested and the results are compared with published results. The algorithm is very efficient, giving the diagrams of isotherms of high accuracy even for rough finite element mesh and relatively long time increment. Author (CISTI)

N93-20691# Windsor Univ. (Ontario). Civil and Environmental Engineering.

TIME DEPENDENT FORMULATION OF THE HEAT TRANSFER PROBLEM IN NONHOMOGENEOUS MEDIA **c34**

B. B. Budkowska and I. Kreja (Gdansk Technical Univ., Poland.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 532-533 (For primary document see N93-20616 07-39)

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An exact temporal formulation of the heat transfer problem for nonhomogeneous materials with time and temperature dependent material properties is presented. Using weak formulation and the finite element method to solve conduction problems, a solution is obtained at each time step. The numerical algorithm for the description of the variable properties of the material as well as unknown temperature is obtained by introducing the concept of temporal incremental decomposition which leads to nonlinear system of equations for the nodal temperatures. The Newton Raphson scheme is an effective procedure to cope with this type of problem. This formulation of the heat transfer problem in nonhomogeneous media with time and temperature dependent properties was analyzed by means of some numerical examples and compared with results of similar tests published in scientific literature. They comprised two dimensional problems of plane and axisymmetric type. The tested examples were considered in detail regarding mesh, convergence, stability criteria, accuracy, reduced numerical integration technique, and common Gauss integration procedure. The obtained results were promising. Author (CISTI)

N93-20692# Miami Univ., Coral Gables, FL. Clean Energy Research Inst.

OPTIMIZING LIQUID HYDROGEN STORAGE SYSTEMS **c31**

S. Gursu, S. A. Sherif, T. N. Veziroglu, and J. W. Sheffield (Missouri Univ., Rolla.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 540-541 (For primary document see N93-20616 07-39)

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Boil off losses associated with the storage, transportation, and handling of liquid hydrogen can consume up to 70 percent of the available combustion energy. Ortho-para hydrogen conversion, sloshing, and heat leaks all contribute to the problem. After liquefaction of hydrogen the ortho hydrogen is converted slowly over several days to the lower energy para hydrogen. The heat of transformation associated with this process will result in vaporization of 70 percent of the hydrogen. Two optimization methods to reduce boil off losses, one pertains to minimizing ortho-para conversion losses and the other to determining optimum storage pressure, are examined. Also discussed are the effect of the configuration of cooling stations and expansion valves on the boil off rate. A computer program was developed which takes as inputs the step size of the Euler method, liquid hydrogen addition rate, and the ortho fraction, and solves the resulting simultaneous equations. Author (CISTI)

N93-20693# Alberta Univ., Edmonton. Dept. of Mechanical Engineering.

ON THE THERMOELASTOHYDRODYNAMIC LUBRICATION DIMENSIONLESS PROBLEM FORMULATIONS **c37**

C. M. Rodkiewicz and K. Hou (National Research Council of Canada, Victoria, British Columbia.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 602-603 (For primary document see N93-20616 07-39)

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There are significant advantages in presenting engineering problems in the dimensionless form. This procedure generates independent dimensionless parameters which appear in the governing differential equations and their time and boundary conditions. The solution of such a system of equations will depend on these parameters. Consequently, any solution result can be conveniently discussed and presented in terms of these parameters, and not necessarily in terms of the greater in number dimensional physical quantities. Furthermore, each of the pertinent parameters, which correspond to those commonly used in the fluid mechanics and heat transfer considerations, has a significant physical meaning allowing one to judge the relative importance and contribution of various modes of the problem at hand. Presenting thermoelasto hydrodynamic lubrication (TEHL) problems in the dimensionless form has been done in the past. However, invariably, the obtained dimensionless quantities are not recognizable from the point of view of the standard parameters used in the fluid mechanics and in the heat transfer problem considerations. Since the TEHL and elasto hydrodynamic lubrication (EHL) problems are predominantly heat transfer and fluid mechanics problems, it is postulated that the pertinent dimensionless quantities defined, in some instances tabulated, and commonly used in these branches of the engineering science should be consistently and uniformly used throughout the TEHL and EHL considerations. Author (CISTI)

N93-20694# Tokyo Inst. of Tech. (Japan). Dept. of Aerospace Engineering.

ANALYSIS OF HYSTERESIS IN SHAPE MEMORY ALLOYS DURING THERMAL CYCLIC LOADING **c26**

Kikuaki Tanaka and Hisaaki Tobushi (Aichi Inst. of Tech., Toyota, Japan.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 604-605 (For primary document see N93-20616 07-39)

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The stress induced in shape memory alloys, called recovery stress, and the strain temperature hysteresis are studied using a theoretical approach based on a constitutive equation for the transformation process in the material together with transformation kinetics for the martensitic transformation and the reverse transformation. Deformation during the forward and reverse transformation due to temperature cycling and a constant applied stress is considered. If the temperature range is wide enough to cover both the martensitic and reverse transformation zones, a full deformation temperature hysteresis loop is observed. If the temperature range only partly covers this zone, a partial hysteresis is observed. The process can be fully traced under constant stress for a given temperature cycling. The threshold stress at which the transformation starts or completes can be determined from tensile test data. Numerical results are presented for the Cu-Zn-Sn alloy. Author (CISTI)

N93-20695# Aichi Inst. of Tech., Toyota (Japan).
DEFORMATION OF TiNi SHAPE MEMORY ALLOY UNDER THERMOMECHANICAL CYCLES **c26**
H. Tobushi, H. Iwanaga, K. Tanaka (Tokyo Inst. of Tech., Japan.), T. Hori, and T. Sawada *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 606-607 (For primary document see N93-20616 07-39)
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In actuators, robots, and solid state heat engines, shape memory alloys are used as working elements and such elements are accompanied with cyclic motions. In these cases, a decrease in recovery deformation and recovery force may occur. To evaluate the reliability of the shape memory alloy element, an understanding of the characteristic values subjected to thermo mechanical cycles is important. The cyclic properties of shape memory alloys subjected to thermo mechanical cycles are discussed. The cyclic properties of yield condition in the stress induced martensitic (SIM) transformation and the recovery deformation caused by both transformations are reviewed. Experiments with cyclic loading - unloading and experiments with thermal cycles under constant stress were carried out. The material used was a TiNi shape memory alloy wire of which the outer diameter was 0.75 mm and the gauge length was 20 mm. Author (CISTI)

N93-20696# Concordia Univ., Montreal (Quebec). Dept. of Mechanical Engineering.
STOCHASTIC FINITE ELEMENT ANALYSIS FOR HIGH SPEED ROTORS **c37**
T. S. Sankar, S. Anantha Ramu (Indian Inst. of Science, Bangalore.), and R. Ganesan *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 610-611 (For primary document see N93-20616 07-39)
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A general finite element method is developed for the dynamic analysis of complex rotor systems in which several of the system parameters are stochastic quantitites. The stochastic characteristics of the free and forced vibration response are derived in terms of the stochastic material property characteristics. An equation is developed in which the variations of the modulus of elasticity and the mass density along the length of the shaft are represented as small fluctuations about their mean values and in terms of two independent, one dimensional, univariate real stochastic fields which are homogeneous with zero mean values. These are described through their variances and autocorrelation function. The Lagrangian equations of motion for the element when the system is rotating at a constant velocity are derived. The equation of motion of free vibration are reduced to the eigenvalue problem. Each stochastic process is characterized by three parameters: the mean, standard deviation, and scale of fluctuation so that the second order properties can be adequately extracted. The local average of any stochastic process and the cross covariances between any two stiffness coefficients or any two mass coefficients can be derived. The stochastic properties of the solution of the eigenvalue problem are determined by the perturbation method. Author (CISTI)

N93-20697# Nanyang Technological Inst. (Singapore).
IMPROVEMENT TO THE HIGHER ORDER FINITE STRIP METHOD
P. W. Khong *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 616-617 (For primary document see N93-20616 07-39)
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In stress analysis, the energy principles are used in the Rayleigh Ritz method to obtain approximate solutions to elasticity problems. In the Rayleigh Ritz method a continuum, infinite degrees of freedom system, is approximated by a finite number of degrees of freedom system. The method thus reduces the problem to that of solving a set of simultaneous algebraic equations. The method is employed in the finite element method and the finite strip method which is concerned with replacing continuum problems with those pertaining to substitute discrete systems. The solutions can then be computed and evaluated through computing machines. A methodology of improving the accuracy with no change of the finite series used is presented. The conventional compatible finite strip method is restricted to structures with constant thickness and material properties. The approach is generalized to deal with discontinuous thickness and material properties without additional requirements. Author (CISTI)

N93-20698# Sherbrooke Univ. (Quebec). Dept. of Civil Engineering.
NONLINEAR ANALYSIS OF PLATES BY THE FINITE ELEMENT METHOD
Mohamed Lachemi and Antoine E. Lahoud *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 620-621 (For primary document see N93-20616 07-39)
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Nonlinear analysis is generally difficult and time consuming; it requires great care in algorithm development and implementation. The finite element method has been used extensively in the nonlinear analysis of structures. The finite element analysis of thin plates of arbitrary geometry and material behavior is considered, allowing for the possibility of large deflections and membrane forces. The finite element formulation is presented and validated by analyzing two plates for which experimental or analytical results are known. The analysis is incremental and can take into account geometrical as well as material nonlinearities. A conforming four node quadrilateral element which was developed for the analysis of plates in bending was shown to be efficient for the nonlinear analysis of plates when used with the proposed algorithm. Analyses are presented of two examples to validate the algorithm and demonstrate the efficiency of the conforming element. The second case considered is that of a square plate built-in at all edges with a uniform load applied to it. Author (CISTI)

N93-20699# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
EXACT FINITE ELEMENT METHOD
Kaiyuan Yeh and Zhenyi Ji (Anhui Architectural Industry Coll., Hefei, China.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 626-627 (For primary document see N93-20616 07-39)
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A new exact finite element method is suggested for solving non-positive and positive definite partial differential equations with arbitrary variable coefficients. By the present method, the compatibility conditions between elements can be easily treated. Its convergence is proved and the higher order derivatives at element node have a high convergence rate. A numerical example is presented for a non-positive definite partial differential equation with variable coefficient. Author (CISTI)

N93-20700# Carleton Univ., Ottawa (Ontario). Dept. of Mechanical and Aerospace Engineering.
BOUNDARY ELEMENT FRACTURE MECHANICS ANALYSIS IN PLANE ORTHOTROPIC ELASTICITY
C. L. Tan and Y. L. Gao *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 628-629 (For primary document see N93-20616 07-39)
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Solutions to problems in anisotropic elasticity are important in the strength analysis of advanced composite materials and structures. An efficient, available computational tool for stress analysis is the boundary element method (BEM). Reports of its applications to anisotropic elasticity remain rather limited. The quadratic isoparametric element numerical formulation is employed in the BEM analysis of plane orthotropic bodies containing cracks, the objective being to develop a quick and efficient procedure for obtaining the stress intensity factors in such problems. To this end, quarter-point traction singular crack-tip elements are introduced to represent more accurately the near-tip fields. Indeed, with these elements, the stress intensity factors can be accurately obtained, with relatively coarse mesh discretizations, directly from the boundary integral equation (BIE) computed nodal displacements of these quarter-point elements on the crack faces, or from the computed nodal traction at the crack tip. This, however, has not been previously demonstrated for BEM analysis in orthotropic elasticity. Author (CISTI)

N93-20701# Naval Postgraduate School, Monterey, CA. Dept. of Mechanical Engineering.
BOUNDARY ELEMENT SHAPE FUNCTION FOR BIMATERIAL INTERFACE CRACKS
Y. W. Kwon and R. Dutton (Missouri Univ., Rolla.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 630-631 (For primary document see N93-20616 07-39)
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The order of the stress singularity at the crack tip normal to the

interface of two different materials varies depending on the material properties of the two materials. The current shape function developed for homogeneous materials cannot represent the order of stress singularity in such materials. The correct order of interpolation function for tractions and displacements is used to solve such interface crack problems using a subdomain boundary element technique. Examples of a homogeneous plate with double edge cracks and of a crack in a bimaterial were solved using the boundary element method. The crack tip, located perpendicular to the interface of two materials has a stress singularity which varies depending on the ratio of shear moduli of the two materials. Thus, a shape function which has correct interpolations for both traction and displacement was used to model the crack tip singularity. A subdomain technique was used to handle the nonhomogeneity. Analyses of the interface crack problems using this approach yielded comparable results to analytical solutions.
Author (CISTI)

N93-20702# Laval Univ. (Quebec). Dept. of Mechanical Engineering.
APPLICATION OF THE BEM TO THE CRACK GROWTH PROBLEM BY THE COUPLING OF DAMAGE-DEFORMATION
Xiangan Kong *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 632-633 (For primary document see N93-20616 07-39)
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A boundary element method (BEM) in which the concept of continuum damage mechanics and coupling between elasto visco plastic deformation and isotropic damage development is used, is applied to several problems. These problems include crack initiation in concrete and high frequency fatigue crack growth in a nickel based alloy. One of the advantages of the BEM is that the stiffness matrix is constant over time. The alloy fatigue problem is carried out on an axisymmetric fatigue specimen. As a result of the use of symmetry only such boundary element equations whose variables lie on half of the boundary need be solved. In addition, because there are no nodes on the symmetry axis, the order of boundary element equations is less than that of ordinary symmetrical structures. Author (CISTI)

N93-20703# Technical Univ. of Istanbul (Turkey).
A RECENT BOUNDARY INTEGRAL PROCEDURE ON DETERMINING SHEAR CENTERS, WARPING CONSTANT AND OTHER CROSS SECTIONAL PROPERTIES OF A TURBINE BLADE **c37**
Vedat Karadag *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 638-639 (For primary document see N93-20616 07-39)
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In the present work, the cross sectional properties, including the shear centers and warping constants, of turbomachinery blades have been satisfactorily calculated by the boundary integral method. The St. Venant warping function has been chosen as a special function which is obtained by addition of a known function and an unknown function, and as a classical single function in solving the Neumann problem. Using this special warping function and the single warping function, the shear centers and warping constant and other cross sectional properties of asymmetrical turbomachinery blades have been calculated by the boundary integral method. Comparisons are made between several available exact and approximate published values. In the special warping function case, the accuracy obtained has been improved considerably in practical applications. The improvement on the accuracy has been shown on the several examples of asymmetrical cross sections used in industry. Comparisons have also been made between several polynomial approximations of boundary curves of cross sections. These comparisons also give correct guidelines in the solutions of integral equations. Shear coefficients of several cross sections are also calculated for practical applications. The influence of the approximation type of the boundary curve has also been shown to be important. Author (CISTI)

N93-20704# Laval Univ. (Quebec). Dept. of Mechanical Engineering.
A BOUNDARY ELEMENT FORMULATION FOR THERMO-HYDRODYNAMIC LUBRICATION PROBLEM **c37**
A. Gakwaya and B. Imcaoudene *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 640-641 (For primary document see N93-20616 07-39)
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An approach to modeling thermohydrodynamic lubrication is presented beginning with formulation of equivalent integral equations that give the velocity, pressure, and temperature distribution in the flow domain and its boundary. The features pertinent to the lubrication field are then introduced into the model by creating specialized modules that handle the numerical integration or that calculate appropriate boundary conditions. This paper presents an all direct integral equation formulation and numerical solution of the complete equations that are fully compatible with the assumption of incompressible thermo-viscous flow of a Newtonian fluid used in lubrication theory. The use of the boundary element method (BEM) permits a natural approach in modeling such a surface phenomena as lubrication. In the present implementation, an isoparametric quadratic boundary elements formulation is used and conforming as well as nonconforming elements are utilized as required by the geometric features of each domain. Specialized polynomial transformations are employed to handle the different kinds of singularities. Author (CISTI)

N93-20705# Laval Univ. (Quebec). Dept. of Mechanical Engineering.
BOUNDARY ELEMENT FORMULATION FOR THERMOELASTOHYDRODYNAMIC CONTACT PROBLEMS **c37**
A. Gakwaya and D. Despres *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 642-643 (For primary document see N93-20616 07-39)
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This paper presents a boundary element formulation and numerical solution of lubricated contact problems. It uses the full Navier-Stokes equation for thermoviscous incompressible lubricant fluid and the thermoelastic equations for the contacting solids. These equations form a coupled system that is written into equivalent boundary-domain integral equations which are then discretized using both conforming and nonconforming boundary elements. The resulting set of nonlinear algebraic equations is solved iteratively using a fixed point algorithm. The corresponding computer model is then applied to study the local as well as the global behavior of some thermoelastohydrodynamic (TEHD) contact problems that include a slider roller and a pair of spur gear teeth. Both the solids and the lubricant are studied by the boundary element method (BEM). In order to assess the validity and usefulness of the computational scheme, several example problems have been solved that include a hydrodynamic slider bearing and lubrication of a pair of spur gear teeth under thermomechanical loading. The results obtained are quite satisfactory when compared to those obtained by other methods and demonstrate the validity of such a natural approach for modeling surface phenomena by the boundary element method. The limitations encountered in this study were purely of numerical type and are related to the accurate numerical evaluation of singular integrals in very thin geometries (fluid layer).
Author (CISTI)

N93-20706# Wright State Univ., Dayton, OH. Dept. of Mechanical and Materials Engineering.
COMPUTER-ORIENTED CLOSED-FORM ALGORITHM FOR CONSTRAINED MULTIBODY DYNAMICS FOR ROBOTICS APPLICATION **c63**
Junghsen Lieh *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 646-647 (For primary document see N93-20616 07-39)
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An alternative computerized algorithm for the dynamics of constrained and controlled multibody systems is presented. The algorithm is derived from the principle of virtual work and includes the effects of a moving reference frame. The equations of motion are established in a closed form. The closed form provides a clearer physical insight into system structure and facilitates linerization. The formalism simplifies the computer programming and avoids tedious matrix manipulation. The equations of motion are expressed in terms of a minimum set of variables and save CPU time and memory. The effects of an accelerating reference frame has been included. A symbolic program ROBOT is developed based on the closed form formalism. A computer model of a biped walking on a vibrating platform is generated using the above approach. Dynamic behavior of the biped is studied using the optimal control theory. The study shows that this closed form formalism holds promise in the simulation of constrained robotic systems. Author (CISTI)

N93-20707# Noranda Technology Centre, Pointe Claire (Quebec).
MODELLING OF MULTI-LINK SPATIAL FLEXIBLE MANIPULATORS EMPLOYING THE FINITE ELEMENT METHOD
Philippe E. Gaultier and William L. Cleghorn (Toronto Univ., Ontario.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 648-649 (For primary document see N93-20616 07-39)
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Difficulty in modeling flexible manipulators has arisen primarily as a result of the restrictions of the modal expansion method and secondly, the shear complexity of the equations developed and variance in manipulator geometry. To alleviate the restrictions of the modal expansion method, the finite element method has been introduced by several investigators. Special features of the spatial beam element presented here include the added effects of longitudinal loads on lateral vibration, internal and external damping, and actuator and payload masses. A method of applying the element to manipulators is generalized, insofar as the kinematics and motion profile. With regards to connectivity of the beam elements, the reference frames of a manipulator are coupled by an orthogonal transformation matrix. Thus, nodes located on link joints are also coupled. Global variables are prescribed with respect to an element fixed reference frame. A good approximation of the motion of the manipulator is obtained by a quasi-static solution to the differential equations. The beam element developed is an effective tool for analysis of manipulators where flexibility is of interest. Studies using this element could anticipate large end effector errors and times at which the steady state oscillation is small enough for the manipulator to be considered positioned. Euler Bernoulli beam theory may prove inadequate when modeling manipulators where shear effects are prominent. Author (CISTI)

N93-20708# Victoria Univ. (British Columbia). Dept. of Mechanical Engineering.
MULTIPLE-ARM JOINT RATE SOLUTION BY BRANCH RESULT ASSEMBLY **c37**
Ron P. Podhorodeski *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 650-651 (For primary document see N93-20616 07-39)
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The inverse velocity problem involves finding joint rates which produce a desired end effector angular and translational velocity. A robot is kinematically redundant when more joint degree(s) of freedom (DOF) exist than required. In this case, an infinite number of joint rate solutions will exist and a method of selecting the best joint rates is required. In this paper, an approach for deriving general joint rate solutions for kinematically coupled multiple-arm devices is discussed. General joint rate solutions, in terms of an assembled Jacobian null-space basis and an assembled particular solution, for redundant multiple-arm systems sharing common degrees of freedom were formed by concatenation of branch results. The method has the advantage of allowing the majority of the computations or derivations associated with finding rate solution for the multiple-arm device to be performed at the individual branch level. Author (CISTI)

N93-20709# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
COMPARISON OF THE EFFICIENCY OF THE VARIOUS METHODS FOR RIGID-BODY DISPLACEMENT ANALYSES
R. G. Fenton and F. Xi *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 652-653 (For primary document see N93-20616 07-39)
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The state of a rigid body in the space can be expressed by one of the following three state descriptions: space description (SD), vector description (VD), or three point description (TPD). A general displacement of a rigid body from its initial to final state can be considered as being the result of a translation followed by a rotation. Different ways of describing the combination of translation and rotation, lead to different motion representations, of which the following three may be most commonly used: homogeneous transformation (HT) based on Cartesian coordinates; screw transformation (ST) based on screw axes: and the algebra of rotations (AR) based on vector expression. The objective of this paper is to evaluate the relative computational efficiency of the aforementioned three motion representations considering the aforementioned three state descriptions. This problem becomes important for the forward and inverse finite kinematic analysis of manipulators where the computation must be repeatedly performed on-line during motion control. Author (CISTI)

N93-20710# Memorial Univ. of Newfoundland, Saint Johns.
EFFICIENT AND ACCURATE ON-LINE COMPUTATION OF MOTOR TORQUES FOR ROBOTIC MANIPULATORS **c37**
A. M. Sharan and C. Dhanaraj *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 654-655 (For primary document see N93-20616 07-39)
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Real-time computation of the inverse dynamics of the robotic manipulators is required for ensuring robot control. This paper presents a modified Newton-Euler algorithm which makes use of symbolic programming for improved computational efficiency. Also, friction is incorporated in the dynamic model for more accurate prediction of torques. The algorithm is parallelized using a task streamlining approach, a systematic mapping scheme using layered task graphs to create the list schedule and a simplified bin-packing heuristic algorithm to schedule the computations on a multiprocessor. The resulting computational load is only $12n+p$ flops (n=number of links in the manipulator), indicating a promise for application to precision robot control employing a high sampling rate. It has been shown that friction torques can be computed for greater accuracy of the dynamic model, modeling the joint friction using Coulomb's laws and the transmission friction, using the input-output function of the transmission system. The task streamlining approach was developed to decompose the inverse dynamic tasks into identical subtasks and to schedule in an efficient manner, resulting in a minimum processing time of 3.56 ms.
Author (CISTI)

N93-20711# McGill Univ., Montreal (Quebec). Dept. of Mechanical Engineering.
THE LINEAR INVARIANTS OF THE COMPOSITION OF TWO ROTATIONS **c64**
Jorge Angeles and Murat Tandirci *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 656-657 (For primary document see N93-20616 07-39)
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The calculation of the rotation resulting from the composition of two rotations often arises in multibody kinetics and dynamics. The integration of kinematic relations providing the updating of the rotation matrices involved is marred with truncation and roundoff errors. As a result, the updated matrix may fail to be properly orthogonal. As a means to remedy this situation, it is possible to represent the attitude of a rigid body through its rotation invariants. The linear or the quadratic invariants of the rotations are used to represent rotation. They are best known as the Euler-Rodrigues parameters of the rotation. The quadratic invariants are derived from the axial vector and the trace of the said rotation. In using a set of invariants, economies are realized in that the sets contain only four of the scalar quantities. Additionally, whatever errors the integration procedure may produce, the updated values will always define one rotation. Formulae for the Euler-Rodrigues parameters of the composition of two rotations in terms of the linear invariants do not appear in the literature. Presented in this paper is the derivation of the linear invariants of the product of two rotation matrices in terms of those of the two factor matrices. The algorithm allows the required calculations to be performed with vector operations. The computational complexity of the proposed algorithm is also included in this paper. Author (CISTI)

N93-20712# McGill Univ., Montreal (Quebec). Dept. of Mechanical Engineering.
ON THE FORMULATION OF LINEAR HOMOGENEOUS VELOCITY CONSTRAINTS IN MECHANICAL SYSTEMS **c64**
Subir Kumar Saha and Jorge Angeles *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 658-659 (For primary document see N93-20616 07-39)
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Within the framework of the methodology termed the natural orthogonal complement, both holonomic and nonholonomic constraints are expressed as a system of equations that are linear and homogeneous in the twists of all the bodies of the system. Here, a six dimensional vector containing the necessary and sufficient information determining the velocity field

throughout the body is used to describe the twist of a body. Thus, it contains the three components of angular velocity vector of the mass center, although any other point of the body could be used. The crucial step in successfully modeling a broad class of mechanical systems with the natural orthogonal complement is the representation of the kinematic constaints. This formulation is illustrated as applied to a differential gear train. Simulation results are also included. It is apparent that a kinematic constraint, whether holonomic or nonholonomic, can be written in the form of a linear homogeneous equation involving the twists of every pair of coupled bodies of a mechanical system. This approach departs from that reported in the literature of deriving independent scalar constraint equations that are linear in the body twists, but not necessarily homogeneous. In fact, the homogeneity of those constraint equations allows us to regard all constraints as scheleronomic. Author (CISTI)

N93-20713# Carleton Univ., Ottawa (Ontario). Dept. of Systems and Computer Engineering.

NONLINEAR FRICTION EFFECTS ON PRECISE MOTION CONTROL OF A MANIPULATOR **c37**

G. D. Warshaw, A. Jnifene (Ottawa Univ., Ontario.), and D. Necsulescu (Ottawa Univ., Ontario.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 660-661 (For primary document see N93-20616 07-39)

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The need for accurate robot manipulators generated in the last few years an active interest in the effects of nonlinear friction on position and force control of a robot arm. Linear viscous friction has been easily included in robot dynamics models while the inclusion of nonlinear discontinuous friction, and in particular stiction end Coulomb friction resulted in more complex computational requirement for robot dynamic simulation and compensation. A detailed analysis, based on simulations, is performed in order to identify the problem posed by stiction end Coulomb friction on controlling low speed motion in the vicinity of a target point for a robot servomotor and a jointed two-degree of freedom robot arm. The effect of the limited bandwidth of the actuators on filtering the discontinuous friction torque in the closed loop control scheme is investigated. The local effects, around the low speed motion in the vicinity of a moving target for a two-degree of freedom arm is also analyzed. It was shown that the discontinuous nature of the nonlinear stiction end Coulomb friction around zero velocity motion leads to positioning accuracy problems in robot motion control. The apparent erratic behavior at low velocity motion is caused by the discontinuous friction torques which can also excite higher frequency vibration modes which are not usually taken into account in the controller design. Author (CISTI)

N93-20714# Victoria Univ. (British Columbia). Dept. of Mechanical Engineering.

STABILIZATION OF KINEMATICAL CONSTRAINTS FOR OPEN MULTIBODY CHAINS **c64**

I. Sharf and Gabriele M. T. DeLeuterio (Toronto Univ., Ontario.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 662-663 (For primary document see N93-20616 07-39)

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A model to describe the dynamics of a constrained multibody system is formulated using the dynamical equations of motion and the kinematical equations of constraint. The former are functionally treated as a set of differential equations, the latter as a set of algebraic equations. If the differential equations are integrated numerically, the resulting solution cannot be expected to, and usually does not satisfy the algebraic constraints owing to the errors incurred through the use of an approximate integration procedure. Violation of these constraints may have a significant effect on the accuracy of the numerical results. The objective of this paper is to present three numerical methods for maintaining solution invariants during numerical integration applied in the context of a specific problem: simulation dynamics of open multibody chains with rigid and/or structurally deformable members. These methods were chosen as representative of the different approaches to constraint stabilization problems and are most often quoted on the subject. These methods are: Baumgarte's, Gear's, and the method of elimination. The results indicate that the methods of Gear and Baugarte, although they achieve stabilization of constraints, do not necessarily produce the correct numerical solution for the state. Furthermore, since these techniques are approximate, their capacity to force the solution onto the invariant manifold is inherently limited. The method of elimination yields a solution which satisfies the constraints exactly. Moreover, if one can apply it without resorting to special numerical schemes to reduce the order of the system, this procedure is typically the most efficient one.

Author (CISTI)

N93-20715# Wollongong Univ. (Australia). Dept. of Mechanical Engineering.

LOAD CARRYING CAPACITY FOR A TWO-LINK PLANAR FLEXIBLE ARM **c37**

M. Habibnejad Korayem, Y. Yao, and A. Basu *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 664-665 (For primary document see N93-20616 07-39)

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A recursive Lagrangian formulation of flexible manipulators has been applied for determining load carrying capacity of a two link planar flexible arm. To derive equations of motion for the manipulator, the position of a point on the beam is described with a combination of rigid body motion and flexible deflection using a Bernoulli Euler beam model. Both joints of the manipulator are assumed rotary and rigid. A 4 by 4 homogeneous transformation matrix represents each link's coordinate system with respect to the previous link's coordinate system. A point along the link is described in a fixed reference system by the joint transformation and the link transformation. The flexible deflection of links are approximated with two assumed mode shapes which are the product of admissible shape functions and time dependent generalized coordinates. Velocity and acceleration vectors are obtained through differentiation of position vectors over time. The kinetic and potential energies are formulated. The dynamic equation of a flexible manipulator is obtained using Lagrange's equations of motion. If the torque speed characteristic curves of the actuator are available, the load carrying capacity for any given end effectuator motion trajectory can be determined. Author (CISTI)

N93-20716# Moncton Univ. (New Brunswick).

MODELLING ROBOT TRAJECTORY ERRORS USING TIME SERIES **c64**

Roger Boudreau and Edmund Biden (New Brunswick Univ., Fredericton.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 666-667 (For primary document see N93-20616 07-39)

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When a robot manipulator is programmed to follow a specific path, corrective compensation torques are usually applied to the joint actuators in order to ensure an actual trajectory as close as possible to the desired one. Accuracy is dependant on the adequate modeling of the robot for control purposes. This paper presents a time series approach to modeling robot trajectory errors. It is found that the Autoregressive Moving Average (ARMA) models can be used to forecast trajectory errors when the position of the robot end effector is known in Cartesian space. The results show that time series obtained by this approach are an efficient way of predicting future deviations. It was found that models obtained in one location of the plane could give good predictions at other locations. If similar general models can be found to describe the entire workspace then they can be incorporated as part of the robot's control algorithm to reduce tracking errors. Author (CISTI)

N93-20717# McGill Univ., Montreal (Quebec). Dept. of Mechanical Engineering.

STRUCTURAL SHAPE OPTIMIZATION OF ROBOTIC LINKS **c37**

J. Ghattas and J. Angeles *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 668-669 (For primary document see N93-20616 07-39)

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In the design of robotic manipulators, the architecture of the manipulator, which comprises the well known Hartenberg Denavit (HD) parameters, is determined from kinematic considerations. This is followed by the detailed mechanical design of the manipulator components, including links. This paper presents a method for the optimal structural design of the geometric shape of the links, for a given manipulator architecture and functional constraints arising from motor specifications. The method minimizes the weight of the links, subject to constraints on stress, deflection, and natural

frequencies. The links are modeled as solids of arbitrary shape under no assumptions such as symmetry. The calculation of stress, displacement, and natural frequencies and modes is done using finite elements.
Author (CISTI)

N93-20718# Laval Univ. (Quebec). Dept. of Mechanical Engineering.
POLYNOMIAL SOLUTION OF THE DIRECT GEOMETRIC PROBLEM OF A PARALLEL SPHERICAL MANIPULATOR [SOLUTION POLYNOMIALE AU PROBLEME GEOMETRIQUE DIRECT D'UN MANIPULATEUR PARALLELE SPHERIQUE] c37
Clement M. Gosselin and Jaouad Sefrioui *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 670-671 In FRENCH (For primary document see N93-20616 07-39)
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Although kinematic chains have long been used in the mechanical conceptualization of systems, their application to robotic manipulators is very recent. Manipulators based on parallel chains have the advantage of offering great structural rigidity and permit the actuators to be moved toward the base. Some work undertaken relates to spherical manipulators with three degrees of freedom. In this article, a polynomial formulation of the direct geometric problem is derived for the manipulator. It is then possible to show that the maximum number of solutions for this problem is eight since an eight degree monovariable polynomial is obtained. An example is presented of an articulated configuration of a manipulator for which eight real solutions exist. Author (CISTI)

N93-20719# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
LINEAR PASSIVE IMPEDANCE c64
Shahram Payandeh and Andrew Goldenberg *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 672-673 (For primary document see N93-20616 07-39)
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This paper presents fundamental results on the model of two solid bodies in contact, for example the grasped object and the environment. It is also shown that the model of the grasped object should include spring and/or damper models when it makes contact with the environment. It is shown that if the parameters of the impedance model of the grasped object satisfy passivity conditions, the system is also stable. This leads to designing devices which can produce desired spring and damping properties. A general property of this kind of device in terms of passivity is discussed. It is shown that if the device has the general property of passivity, then the device will be stable in an input/output sense. Author (CISTI)

N93-20720# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
GRASP ADMITTANCE CENTER. A CONCEPT c37
K. B. Shimoga and A. A. Goldenberg *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 674-675 (For primary document see N93-20616 07-39)
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The ultimate goal of the research on articulated hands in general is to use them to do tasks in a way similar to that of humans. A systematic analysis reveals that the day-to-day tasks of humans include some common task primitives such as twist, turn, insert, pullout, push, pull, lift, and place. During each of these operations, the grasp dynamic behavior plays an important role and more so in tasks involving manipulation of delicate objects. Introduced in this paper is the concept of the grasp admittance center, a notion that aims to make an articulated grasp exhibit a directionally decoupled dynamic behavior. An admittance center is conceptualized as the superposition of compliance, accommodation, and mobility centers in a desired coordinate frame. A grasp with an admittance center will have three useful features: stability, decoupled force motion relation, and decoupled time-response. These features are also useful to other closed kinematic chain robotic devices such as the cooperating multiarms and multilegged mobile robots engaged in non-quasistatic (dynamic) manipulation tasks. As a preparation to demonstrate the concept experimentally, a method of synthesizing articulated grasps so as to achieve an admittance center has been developed as well as a method of choosing appropriate location and related parameters for the center. The sensitivity of the center to its parameter imprecision has also been analyzed. Author (CISTI)

N93-20721# British Columbia Univ., Vancouver. Dept. of Electrical Engineering.
ON IDENTIFICATION OF HYDRAULIC COMPLIANCE USING A GENETIC ALGORITHM c37
F. Wan, N. Sepehri, K. Kristinsson, G. A. M. Dumont, and P. D. Lawrence *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 678-679 (For primary document see N93-20616 07-39)
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The novel application of the genetic algorithm (GA) for parameter identification of hydraulically actuated manipulators is currently under investigation. One common characteristic of such systems is high hydraulic compliance, which has considerable effect on the behavior of the system. Identification of hydraulic compliance is beneficial in the following ways: (1) it can be used towards developing an exact model of the system; (2) it can be incorporated into a fault/hazard diagnosis system; and (3) it can be used for improving control strategies. In this paper, the GA is applied to identify the hydrauic compliance. This is demonstrated with the basic hydraulic circuit used in heavy-duty manipulation. The ability of the GA to handle nonlinear functions, finding the global solution, as well as using accumulated information to prune the search space, makes it a good candidate for use in the identification of hydraulic system parameters. It was shown that it can successfully identify the hydraulic compliance; this was demonstrated with the basic hydraulic actuation used in heavy-duty manipulation. Author (CISTI)

N93-20722# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
THE NEXT REVOLUTION IN COMPUTER-AIDED ENGINEERING c61
F. A. Salustri and R. D. Venter *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 680-681 (For primary document see N93-20616 07-39)
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A design theory is presented which is a hybrid of the two principal information management paradigms: object orientation and hypertext. The model is globally applicable to applications such as engineering analysis, database management, kinematic analysis, and solid modeling. Design properties which have affected the hybrid model include: (1) design is intensely hierarchical; (2) highly complex objects are often designed and hence must be managed; (3) time histories (version control) of these design objects must be automated; (4) the model must support evolution of design requirements during the course of design; (5) the hybrid model maintains flexibility by supporting extension; (6) a significant portion of design consists of performing minor modifications of an existing design, thus, extensibility and reuse of design components must be supported; (7) constraints on components of a design are the primary expressive form of the criteria for design, thus support for statements of constraints in a natural form must be provided; and (8) it is important for the model to support information sharing as many aspects of design share information. The study of different schemes for ordering information is central to design work. Information organizing mechanisms being investigated are classification by structural and functional properties of the design objects; generalization of classes of objects by similarities of structures and of function; time dependent growth of ad hoc relationships between design objects; and grouping schemes for design objects, especially those relevant to assembly. Author (CISTI)

N93-20723# Manitoba Univ., Winnipeg. Dept. of Mechanical and Industrial Engineering.
TC CURVES AND TS SURFACES AND THEIR APPLICATIONS IN CAD/CAM c61
Yisui Jiang and Ray P. S. Han *In its* Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 700-701 (For primary document see N93-20616 07-39)
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In this paper, the generation of curves and surfaces for computer aided graphical design (CAGD) is re-examined using a different procedure. This result is a TC curve and a TS surface for geometric modeling. The derivation of equations for this curve and surface in three dimensional space is given, and it will be shown that they possess some useful geometric properties which make them very suitable for computer aided design (CAD) applications. These include affine invariant, local control, multiple vertices for more precise control at a given point and at the terminal points of its

characteristic polygon or mesh, convex hull, insertion of cusp and straight line segment, and variation diminishing character. To demostrate the versatility of the method, some curve and surface design examples are depicted. Also, a comparison of the TC curve and TS surface with Bezier and B-Spline is presented. Author (CISTI)

N93-20724# Bristol Aerospace Ltd., Winnipeg (Manitoba).
AN INVESTIGATION OF THE UNEXPECTED ATTITUDE DYNAMICS EXPERIENCED BY THE OEDIPUS-A TETHERED SOUNDING ROCKET PAYLOAD **c20**
G. Tye, R. P. S. Han (Manitoba Univ., Winnipeg.), and T. G. Berry (Manitoba Univ., Winnipeg.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 746-747 (For primary document see N93-20616 07-39)
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On 30 January 1989, the OEDIPUS-A Canadian scientific research rocket was launched. The payload, weighing some 265 kg, actually consisted of two payloads, referred to as the forward and aft payloads, each with their own complement of scientific instruments, control, power, and telemetry systems. An essential scientific requirement was to precisely align the payload with the Earth's magnetic field and separate the two subpayloads along the magnetic field line to a distance of one kilometer while an electrically conducting tether connects the two payloads. During the flight of OEDIPUS-A, all scientific instruments and payload support systems functioned normally and the tethered subpayloads separated to a distance of 960 meters. However, the flight data indicated that although there was virtually no coning increase in the forward payload after separation, the coning in the aft payload increased to approximately 40 deg, which far exceeds the predicted value. In an attempt to understand what may have caused this unexpected dynamic behavior, an investigation was conducted by Bristol Aerospace. This investigation is the subject of this paper. The analysis seems to support the theory that the tether connecting the aft and fore payloads was the cause of the unexpected rapid increase in coning experienced by the aft paylaod. It appears that there are two mechanisms associated with the tether that have influenced the aft payload dynamics. The first is the tether tension which acts as an external force acting on the aft payload and the second is the added energy dissipation. More detailed analysis is needed to fully understand the complex dynamics of this tethered two-body elastic system. Author (CISTI)

N93-20725# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
FREQUENCY RATIO LOCK UP IN THE ATTITUDE DRIFT OF A DISSIPATIVE AXISYMMETRIC GYROSTAT **c35**
A. Kessaris and F. P. J. Rimrott *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 748-749 (For primary document see N93-20616 07-39)
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An analysis is provided of the attitude drift of a dissipative axisymmetric gyrostat. The spin change allotment equations can be expressed in terms of the modified inertia products for platform and rotor, and the corresponding spin changes for the rotor and platform can be expressed in terms of only two variables, the frequency ratio and the attitude angle. An expression for the effective dissipation coefficient of the gyrostat is derived from the expression of the modified inertia products expressed as functions of angular velocities. A phase plane analysis of the resulting reduced equations provides insight into the factors that influence gyrostatic attitude drift. Attitude drift of a gyrostat with dissipation present in both rotor and platform is examined. The critical points and the stability of the null solution are obtained. The critical points for a gyrostat with dissipation in both spinners are shown to be dependent only on the value of the attitude angle. A Liapunov function depending only on the attitude angle is used to examine the behavior of the system in the neighborhood of the critical point in the phase plane. Author (CISTI)

N93-20726# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
SOME OBSERVATIONS OF CHAOTIC MOTION OF SATELLITES WITH DAMPING IN AN ELLIPTIC ORBIT **c18**
X. Tong and F. P. J. Rimrott *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 750-751 (For primary document see N93-20616 07-39)
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Due to its practical importance, planar motion of satellites and its stability under the influence of external disturbances have been investigated. In most cases, periodic motion of satellites in their orbital plane was studied without considering the effect of damping. In an elliptic orbit, the eccentricity of the orbit (e) and the inertia moment ratio (K) have a significant influence on orbital stability. In this paper, the fully nonlinear equation of motion of satellites with damping is investigated numerically to show that for certain parameters e and K, planar motion is chaotic. The characteristics of chaotic motion are shown by means of Poincare maps and phase planes. By numerical simulation, the existence of chaotic motion was confirmed. Period doubling bifurcations as the orbit eccentricity increases was also observed. Such bifurcations succeed infinitely and accumulate to chaos. They occur not only in the oscillating motion of satellites but also in the rotating motion of satellites. Author (CISTI)

N93-20727# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
ON THE NORMALIZED HAMILTONIAN FORMULATION OF THE RESTRICTED THREE-BODY PROBLEM **c64**
Ardeshir Guran, Xiaohua Tong, and F. P. J. Rimrott *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 752-753 (For primary document see N93-20616 07-39)
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Due to the inherent difficulties involved in the treatment of this problem, and to its fundamental importance, the three body problem has been of continuing interest to celestial mechanisms. A limiting special case which exhibits many of the phenomena of the general problem is the case where the motion of the two large masses (known as primaries) is assumed not to be influenced by the third body, but the motion of the third body is governed by the large masses. In classical mechanics, this situation represents the restricted three body problem. In the analysis which follows, the normalized Hamiltonian formulation is extended to this old problem of mechanics. It can be shown that for small values of lambda, the system bifurcation parameter, the point satellite follows a spiral trajectory, while for large values of lambda one has a quasi-periodic motion on a torus. Between these two integrable cases the tori break up into chaotic motion. Author (CISTI)

N93-20728# Florida Atlantic Univ., Boca Raton. Dept. of Ocean Engineering.
A REVIEW OF PROBABILISTIC FATIGUE LIFE ANALYSES FOR WELDED PLATE AND TUBULAR JOINTS
D. V. Reddy and R. Mu *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 754-755 (For primary document see N93-20616 07-39)
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The purpose of this review is to emphasize the need for validation of probability based analysis with measured values of crack propagation and fatigue life of welded T- and tubular joints. Although there is considerable variability in test values, collections of specimen curves indicate geometric and statistical regularity. Therefore, probabilistic analyses can provide a setting for processing the data in a manner suitable for design applications. Also, there is an increasing shift to fracture mechanics-based fatigue life prediction, in comparison with the current S-N cycle approach. The review identified a major shortcoming of the data bases for probabilistic analyses. Although extensive experimental research has been and is still being carried out all over the world, there are still very few data bases of replicate testing, which makes it very difficult to validate probabilistic analysis. Unfortunately, costly and time consuming investigations do not seem to address this deficiency. It is, therefore, hoped that future investigations will correct this problem. Also, there is a need to establish the equivalence of the Markov Chain-based cumulative damage and the fracture mechanics-based methods. Author (CISTI)

N93-20729# Cornell Univ., Ithaca, NY.
PHYSICS-LIKE MATHEMATICAL MODEL FOR CHAOS AND ERGODIC CRITICALITY IN FOUR DIMENSIONS **c77**
M. S. ElNaschie *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 756-757 (For primary document see N93-20616 07-39)
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The present discussion attempts to show some mathematical connections between chaotic dynamics, fractal sets, and dimensionality which may have relevance to physical systems. In particular, starting with

three basic assumptions, an argument is put forth that four dimensions, a dimensionality of special interest in physics, marks a special point in chaotic dimensions. The basic assumptions are that fractals are the carriers of complex strange behavior, that single Cantor sets are somehow the backbone of all strange behavior, and that in one dimension the simplest fractal set is Cantor's middle third set with d(sub c) = log 2/log 3. An expression is derived denoting the nth Cantor-like fractal dimension in n dimensional space and the dimension of the corresponding Euclidian space. An examination of the set shows that, for all n less than 4, the Euclidian dimensionality is greater than the fractal dimensionality, but for n is greater than 4, the Cantor-like fractal dimension becomes much larger than the Euclidian dimension. For n equals 4, the two dimensions are approximately equal and a Cantor-like structure which is nearly a space filling set is obtained. Some possible physical consequences of this phenomena are presented. For instance, if fully developed turbulence has a fractal dimension approximately equal to 6.3, then five dimensional phase space is required to study it. Author (CISTI)

N93-20730# University of Western Ontario, London.

NONLINEARIZATION OF NONLINEAR SYSTEMS UNDER EXTERNAL AND PARAMETRIC RANDOM EXCITATIONS **c65**

C. W. S. To *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 758-759 (For primary document see N93-20616 07-39)

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The response of nonlinear oscillators to stochastic excitations has been extensively studied. When the excitations can be idealized as Gaussian white noise, the response of the system can be represented by a Markovian vector and the joint probability density function of the responses is described by the Fokker Planck Kolmogorov (FPK) equation, exact solution can be obtained. Recently, a statistical or equivalent nonlinearization (SNL) technique has been presented in the literature. In the present paper, the class of solvable reduced FPK equations is adopted here and a simple formula is derived for the equivalent nonlinear damping term. While the present simple formula is similar in form to that in the SNL technique, its derivation is different in two aspects. Firstly, the amplitude and phase transformation used here is different from that used in the SNL technique. Secondly, it is obtained by minimizing the average over phase for the square of the deficiency between the original and approximated nonlinear systems. Unlike most techniques in the literature, the present technique requires no numerical computation prior to the evaluation of the joint probability density function for systems having simultaneous nonlinear dampings and nonlinear stiffnesses. In general, the proposed technique has no restriction on the magnitude of applied forces and size of nonlinearity. Author (CISTI)

N93-20733*# Texas Univ., Austin. Dept. of Aerospace Engineering and Engineering Mechanics.

MODELING THE GROWTH AND INTERACTION OF FRACTURES

Semiannual Progress Report

Mark E. Mear 18 Dec. 1991 10 p

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The research objectives are to develop accurate, efficient numerical tool for fracture mechanics analysis with the capabilities of the method including the modeling of multiple site damage and the simulation of crack propagation. The fracture is modeled using a distribution of edge dislocations. Fundamental solutions for dislocations in an infinite medium, in the neighborhood of a circular inhomogeneity, and near a bi-material interface are incorporated into the procedure to allow exceptionally accurate modeling of fracture geometries involving these types of inhomogeneities. To model arbitrary (finite) domains under general boundary conditions, a combination of the dislocation methodology and boundary element techniques is used. The dislocation scheme is a natural means to model the crack(s), and the boundary element method is an effective way to model the region in which the crack is embedded. The hybrid scheme is relatively easy to use and is very accurate. The research accomplishments are presented.

Derived from text

N93-20879# Technische Univ., Berlin (Germany). Fachbereich Physikalische Ingenieurwissenschaft.

DESCRIPTION OF WRINKLES IN MEMBRANES USING NONLINEAR FINITE PLATE ELEMENTS Ph.D. Thesis [ZUR BESCHREIBUNG VON FALTEN IN MEMBRANEN MITTELS NICHTLINEARER, FINITER PLATTENELEMENTE]

Edgar Leubcke 1992 186 p In GERMAN

(ETN-93-92565) Avail: CASI HC A09/MF A02

Membranes are described as very thin plates of shells with little flexural strength. A problem of stability occurs when a compressive stress is produced at the membrane surface. The membrane straightens and wrinkles occur. Two triangular elements are developed. It is shown how wrinkle formation is less dependent on element boundaries when taking internal rotations into account, behind which cubic arrangements are present. It allows a more accurate description of wrinkles. Examples are given. ESA

N93-20907# Alenia Spazio S.p.A., Rome (Italy). Direzione Tecnica Trasporto.

MSC/NASTRAN STRUCTURE OPTIMIZATION TEST MODULE VERSION 67 (PRELIMINARY) [TEST MODULO OTTIMIZZAZIONE STRUTTURE MSC/NASTRAN VERSIONE 67 (PRELIMINARE)]

G. Attanasio 23 Sep. 1991 86 p In ITALIAN

(Rept-5-191025; ETN-93-92886) Avail: CASI HC A05/MF A01

An evaluation of the structural optimization module Solution 200 of the MSC/NASTRAN version 67 (preliminary) is presented. As well as ascertaining the level of the solutions for which tests could not previously be carried out because of existing code errors, the aim is to verify if such errors are effectively corrected and if eventual changes or implementations are carried out on the optimization module. The following tests are reported: three bar truss, ten bar truss, twenty five bar truss, sixty three bar truss, two bar truss, two shear truss, two squad truss, wing torsion box, cantilever beam, and elements of the Airbus A321. A description of the model and the type of optimization problem to be solved is given for each case. ESA

N93-20915*# Massachusetts Inst. of Tech., Cambridge. Technology Lab. for Advanced Composites.

DAMAGE TOLERANCE AND ARREST CHARACTERISTICS OF PRESSURIZED GRAPHITE/EPOXY TAPE CYLINDERS

Claudia U. Ranniger, Paul A. Lagace, and Michael J. Graves May 1993 42 p Presented at the ASTM 5th Symposium on Composite Materials: Fatigue and Fracture

(Grant NAG1-991)

(NASA-CR-192618; NAS 1.26:192618; TELAC-93-4) Avail: CASI HC A03/MF A01

An investigation of the damage tolerance and damage arrest characteristics of internally-pressurized graphite/epoxy tape cylinders with axial notches was conducted. An existing failure prediction methodology, developed and verified for quasi-isotropic graphite/epoxy fabric cylinders, was investigated for applicability to general tape layups. In addition, the effect of external circumferential stiffening bands on the direction of fracture path propagation and possible damage arrest was examined. Quasi-isotropic (90/0/plus or minus 45)s and structurally anisotropic (plus or minus 45/0)s and (plus or minus 45/90)s coupons and cylinders were constructed from AS4/3501-6 graphite/epoxy tape. Notched and unnotched coupons were tested in tension and the data correlated using the equation of Mar and Lin. Cylinders with through-thickness axial slits were pressurized to failure achieving a far-field two-to-one biaxial stress state. Experimental failure pressures of the (90/0/plus or minus 45)s cylinders agreed with predicted values for all cases but the specimen with the smallest slit. However, the failure pressures of the structurally anisotropic cylinders, (plus or minus 45/0)s and (plus or minus 45/90)s, were above the values predicted utilizing the predictive methodology in all cases. Possible factors neglected by the predictive methodology include structural coupling in the laminates and axial loading of the cylindrical specimens. Furthermore, applicability of the predictive methodology depends on the similarity of initial fracture modes in the coupon specimens and the cylinder specimens of the same laminate type. The existence of splitting which may be exacerbated by the axial loading in the cylinders, shows that this condition is not always met. The circumferential stiffeners were generally able to redirect fracture propagation from longitudinal to circumferential. A quantitative assessment for stiffener effectiveness in containing the fracture, based on cylinder radius, slit size, and bending stiffnesses of the laminates, is proposed. Author

N93-20930 National Physical Lab., Teddington (England). Quantum Metrology Div.

SPECTROSCOPIC INVESTIGATIONS OF BENDING AND MICROBENDING EFFECTS IN SINGLE MODE OPTICAL FIBRE: A FEASIBILITY STUDY

J. M. Benson, T. C. E. Jones, and C. J. Chunnilall (Kings Coll., London, England.) Jul. 1992 13 p

(NPL-QU-90; ETN-93-93063) Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

A feasibility study of the use of Raman spectroscopy as a diagnostic tool for identifying bending in optical fibers is described. Changes in the Raman spectrum are tentatively identified as being due to a stress induced increase in the HV Raman component. This increase is discussed in terms of coupling of Raman signal between whispering gallery modes, which propagate in the cladding in the vicinity of a bend, and the fundamental mode. When the Raman signal is detected in a plane perpendicular to the incident field polarization is termed HV scattering. ESA

N93-21017# Sydney Univ. (Australia). School of Civil and Mining Engineering.

PREBUCKLING DEFLECTIONS AND LATERAL BUCKLING: APPLICATIONS

Yong Lin Pi and N. S. Trahair Nov. 1992 33 p

(PB92-225366; R-646) Avail: CASI HC A03/MF A01

The paper investigates numerically the effects of the in-plane prebuckling deformations on the lateral buckling of beams and beam-columns by using the finite element procedure developed in a companion paper. The numerical results show that the classical predictions of the lateral buckling loads of beams and beam-columns are generally conservative, but the predictions obtained by a linearized procedure which ignores second order terms are overestimated. The predictions by the recommended nonlinear iteration procedure agree well with the experimental results. The effects of span length and the height of the load point have also been investigated. It is shown that lateral buckling is possible for sections where the out-of-plan flexural stiffness is equal to or greater than the in-plane flexural stiffness. GRA

N93-21018# Sydney Univ. (Australia). School of Civil and Mining Engineering.

PREBUCKLING DEFLECTIONS AND LATERAL BUCKLING: THEORY

Yong Lin Pi and N. S. Trahair Nov. 1991 33 p

(PB92-225382; R-645) Avail: CASI HC A03/MF A01

When the ratio of the minor axis flexural stiffness to the major axis flexural stiffness is not small, classic analysis may lead to inaccurate predictions of the lateral buckling loads of beams and beam-columns because the effects of prebuckling deformations are not considered. The energy equation for the elastic lateral buckling of monosymmetric beam-columns including the effects of prebuckling deformations is derived, and the buckling differential equilibrium equations are obtained. A finite element algorithm for the prediction of the lateral buckling loads of monosymmetric beam-columns including the effects of prebuckling deformations is developed from the energy equation. This includes the effects of second order moments due to the prebuckling displacements and the axial loads. An iterative procedure for determining the lateral buckling loads is recommended. The finite element results given in a companion paper show that the classic predictions of the lateral buckling loads of beams and beam-columns are generally conservative, but that the predictions by the linearized procedure are overestimated. The predictions by the recommended nonlinear iteration procedure agree well with experimental results. GRA

N93-21019# Sydney Univ. (Australia). School of Civil and Mining Engineering.

ENERGY EQUATION FOR BEAM LATERAL BUCKLING

Yong Lin Pi, N. S. Trahair, and S. Rajasekaran Apr. 1991 42 p

(PB92-225390; R-635) Avail: CASI HC A03/MF A01

The paper presents a derivation of the classical energy equation for the lateral buckling of doubly symmetric thin-walled beams which is based on the nonlinear relationship between the longitudinal normal strain and the member deformations. The classical equation is compared with an alternative energy equation, and found to be significantly different. The difference is attributed to the omission of some nonlinear components from the longitudinal displacements used for the alternative equation. Comparisons of finite element predictions based on the two energy equations demonstrate some substantial differences. Comparisons with available experimental evidence agree well with the classical predictions, and provide independent evidence that the alternative energy equation is incorrect. GRA

N93-21020# Sydney Univ. (Australia). School of Civil and Mining Engineering.

THE FLEXURAL BEHAVIOUR OF THIN-WALLED SINGLY SYMMETRIC COLUMNS

K. J. R. Rasmussen and Gregory J. Hancock Sep. 1990 45 p

(PB92-225408; R-624) Avail: CASI HC A03/MF A01

The report studies the effect of end support conditions on the flexural behavior of thin-walled singly symmetric columns. It is demonstrated that local buckling does not induce overall bending of fixed-ended singly symmetric columns, as it does of pin-ended singly symmetric columns. As a result of the different effects of local buckling, the strength of a fixed-ended singly symmetric column exceeds that of a pin-ended column of the same effective length. This increase in strength is studied through the transition from pinned to fixed end support by analyzing channel section columns which are elastically restrained against rotations at the ends. The increase is quantified over a range of lengths by analyzing pin-ended and fixed-ended columns as well as columns pinned at one end and fixed at the other. The report also compares the sensitivities of pin-ended and fixed-ended channel section columns to local and overall inperfections. The study is confined to columns whose overall buckling mode is the flexural mode. GRA

N93-21029# Sydney Univ. (Australia). School of Civil and Mining Engineering.

PLASTIC MECHANISM ANALYSIS OF T-JOINTS IN RHS UNDER CONCENTRATED FORCE

Xiao-Ling Zhao and Gregory J. Hancock Nov. 1991 50 p Sponsored in part by Tubemakers of Australia Ltd.

(PB92-225374; R-644) Avail: CASI HC A03/MF A01

A new plastic mechanism is developed for T-joints in rectangular hollow sections (RHS) under concentrated loads. This model includes the plastic hinges in the web, the membrane force in the flange and the strain hardening of the material. It can predict the yield load, the post-yield response, and the ultimate load of a T-joint under concentrated force. The model developed is compared with the CIDECT model, the Kato model, and the modified Kato model. The yield load, the post-yield response, and the ultimate load determined from the present model are compared with 6 T-joint tests performed by Zhao and Hancock (1991) and 20 T-joint tests performed by Kato and Nishiyama (1979). The ratio (beta) of the T-joints tested varied from 0.291 to 0.890. GRA

N93-21232# Queensland Univ., Brisbane (Australia). Dept. of Civil Engineering.

INTEGRATED VIEW OF METHODS IN BUCKLING ANALYSIS

C. M. Wang (Singapore Univ.) and S. Kitipornchai Aug. 1990 33 p Prepared in cooperation with National University of Singapore

(PB93-110468; RR-CE117; ISBN-0-86776-391-4) Avail: CASI HC A03/MF A01

An integrated view of numerical techniques for determining the elastic buckling load of structural members is presented. The commonly used techniques can be grouped under two main approaches, viz. the statickinematic approach and the work-energy approach. Each technique is described briefly and its advantage highlighted. More importantly, the connecting paths between the various techniques are discussed. An understanding of the integrated view and the techniques will provide a greater flexibility for solving buckling problems by employing the most expedient technique for solution. The various methods may also be used independently to solve the same problem to confirm the accuracy, validity, and convergence of the solutions. GRA

N93-21233# Queensland Univ., Brisbane (Australia). Dept. of Civil Engineering.

BUCKLING OF RESTRAINED COLUMNS WITH SHEAR DEFORMATION AND AXIAL SHORTENING

C. M. Wang (Singapore Univ.), Y. Xiang, and S. Kitipornchai Jul. 1990

40 p Prepared in cooperation with National University of Singapore
(PB93-110476; RR-CE116; ISBN-0-86776-389-2) Avail: CASI HC A03/MF A01

There are two well-known approaches proposed for incorporating shear deformation in the analysis of column buckling. Engesser's approach assumes that the shear component acts perpendicularly to the total slope while Haringx's approach assumes that it acts perpendicularly to the bending slope. It appears that discussions are still going on as to which of the approaches is more accurate. It is doubtful if the problem can be resolved through mechanics, as Reissner had pointed out that the approaches depend on the form of the assumed one-dimensional stress-strain relations. This paper will use the Engesser's approach for the shear-flexural buckling analysis of continuously restrained columns. The effect of axial shortening is also considered. A derivation is presented for the total potential energy functional which forms the basis of the finite element method for solution. A parametric study is carried out to investigate sensitivity to various design parameters. GRA

N93-21234# Queensland Univ., Brisbane (Australia). Dept. of Civil Engineering.

BUCKLING OF COLUMNS: ALLOWANCE FOR AXIAL SHORTENING

C. M. Wang (Singapore Univ.), S. Kitipornchai, and F. G. A. Al-Bermani Aug. 1990 33 p Prepared in cooperation with National University of Singapore
(PB93-110484; RR-CE115; ISBN-0-86776-390-6) Avail: CASI HC A03/MF A01

The paper investigates the effect of axial shortening on the following: (1) the elastic buckling of columns with a continuous elastic restraint; (2) the elastic buckling of rotating columns; and (3) the free vibration of columns under a static axial load. These column problems may be solved in a unified approach because the resulting energy functional is similar. The field differential equation is derived by minimizing the energy functional with respect to the lateral displacement function via calculus of variations. The buckling load or fundamental frequency may be obtained by solving analytically the two-point boundary value problem. It was found that the boundary conditions and the restraint parameter or angular velocity parameter affect the influence of axial shortening on the buckling load. In vibrating columns, tensile forces enhance the effect of axial stretching on the fundamental frequency. GRA

N93-21235# Queensland Univ., Brisbane (Australia). Dept. of Civil Engineering.

ULTIMATE STRENGTH OF GEOMETRICALLY IMPERFECT ANGLE COLUMNS

S. L. Chan and S. Kitipornchai Apr. 1991 37 p
(PB93-111771; RR-CE129; ISBN-0-86776-427-9) Avail: CASI HC A03/MF A01

The paper investigates the influence of initial out-of-straightness on the ultimate strength of angle columns. A general unequal angle section has no axis of symmetry. As such, the ultimate angle column behavior is not only dependent on the magnitude but also the orientation of the initial out-of-straightness in the compression member. A numerical incremental-iterative procedure for tracing the nonlinear load-deflection path based on the updated Lagrangian formulation accounting for the effect of partial yielding is presented. The method has been used to predict experimental results obtained by Kitipornchai and Lee (1986b), and to study the sensitivity of the ultimate strength of angle columns to the magnitude and the orientation of the initial out-of-straightness. GRA

N93-21236# Sydney Univ. (Australia). School of Civil and Mining Engineering.

POST-BUCKLING ANALYSIS OF THIN-WALLED CHANNEL SECTIONS UNDERGOING LOCAL AND DISTORTIONAL BUCKLING

Y. B. Kwon and Gregory J. Hancock Feb. 1992 67 p
(PB93-112928; R-650) Avail: CASI HC A04/MF A01

A theoretical method for predicting the post-buckling behavior of thin-walled sections is applied to study the influence of the interaction between local and distortional buckling modes for test channel columns described in an earlier report. The theoretical predictions are based on a nonlinear elastic spline finite strip method for thin-walled sections which has recently been developed. The nonlinear elastic spline finite strip method takes account of geometric imperfections, residual stresses, and non-simple boundary conditions at the ends of the section under study. The method can handle sections buckling simultaneously in local and distortional buckles at different half-wavelengths. The investigation includes convergence studies with different convergence criteria, strip subdivision, and longitudinal subsections so as to determine reliable convergence criteria and the required discretizations for use in the nonlinear elastic spline finite strip method. GRA

N93-21307*# Rensselaer Polytechnic Inst., Troy, NY. Center for Intelligent Robotic Systems for Space Exploration.

SINGLE LINK FLEXIBLE BEAM TESTBED PROJECT Thesis

Declan Hughes Jul. 1992 84 p
(Grant NAGw-1333)
(NASA-CR-192743; NAS 1.26:192743; RPI-CIRSSE-120) Avail: CASI HC A05/MF A01

This thesis describes the single link flexible beam testbed at the CLaMS laboratory in terms of its hardware, software, and linear model, and presents two controllers, each including a hub angle proportional-derivative (PD) feedback compensator and one augmented by a second static gain full state feedback loop, based upon a synthesized strictly positive real (SPR) output, that increases specific flexible mode pole damping ratios w.r.t the PD only case and hence reduces unwanted residual oscillation effects. Restricting full state feedback gains so as to produce a SPR open loop transfer function ensures that the associated compensator has an infinite gain margin and a phase margin of at least (-90, 90) degrees. Both experimental and simulation data are evaluated in order to compare some different observer performance when applied to the real testbed and to the linear model when uncompensated flexible modes are included. Author

N93-21318# Technical Research Centre of Finland, Espoo. Metals Lab.

FATIGUE DESIGN 1992, VOLUME 1

Jussi Solin, ed., Gary Marquis, ed., Aslak Siljander, ed., and Sisko Sipila, ed. 1992 371 p Symposium held in Helsinki, Finland, 19-22 May 1992; co-sponsored by European Structural Integrity Society, and Technology Development Centre of Finland
(VTT-Symposium-130-Vol-1; ISBN-951-38-4081-6; ETN-93-93076)
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The topic of the symposium is the design of structures and machine components subjected to cyclic loading. The papers report recent progress on the prevention of fatigue failure of engineering structures. They cover the fields of fatigue design, analysis and testing through reviews, research reports and illustrative case studies. These two volumes consist of five invited lectures and 46 other presentations by authors originating from 22 countries. They deal with subjects related to service loading, welded structures, surface improvement methods, optimization and numerical analysis (finite element method, boundary element method) multiaxial fatigue, probabilistic approaches, component testing and analysis, case studies and good design practice. Special emphasis is given to multiaxial fatigue, probabilistic aspects and good design practice. For individual titles, see N93-21319 through N93-21340.

N93-21319# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (Germany).

THE SIGNIFICANCE OF SERVICE LOAD DATA FOR FATIGUE LIFE ANALYSIS

Walter Schuetz *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 1 1992 p 11-35 (For primary document see N93-21318 07-39)
Copyright Avail: CASI HC A03/MF A03

Some of the requirements to be met during life service measurements performed to predict fatigue life are discussed. The technical means to measure stresses or loads are considered. The choice of a test bench environment and the counting procedure are discussed. The computation of in-service load fluctuations and how to account for short measurement periods are discussed. The 'omission' and 'truncation' dilemmas are discussed. Problems involved in experimental fatigue life prediction techniques, like length of the return period chosen, and in analytical fatigue life prediction, like accuracy and reliability, are overviewed. ESA

N93-21320# Technical Univ. of Opole (Poland).
MICROCOMPUTER SYSTEM FOR MEASUREMENTS AND ANALYSIS OF SIGNALS FOR FATIGUE LIFE CALCULATIONS UNDER BIAXIAL RANDOM STRESS STATE
Ewald Macha and Henryk Stezala *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 1 1992 p 37-51 (For primary document see N93-21318 07-39)
Copyright Avail: CASI HC A03/MF A03

The algorithm of calculations, hardware and software for the Microcomputer Fatigue Damage Cumulator (MFDC) are presented. MFDC is used for direct determination fatigue life under biaxial random stress state. The equivalent stress history is described by the known methods of cycle counting. Damages are cumulated by linear hypotheses. Owing to the modular structure of software it is possible to calculate fatigue life according to different variants of the algorithm. Some selected examples of application of the discussed computer system to determine fatigue life under biaxial random stress state are presented. Good agreement is obtained by comparing experimental and calculated fatigue life results. ESA

N93-21321# Waterloo Univ. (Ontario). Dept. of Civil Engineering.
THE LEAST AND MOST DAMAGING HISTORIES WHICH CAN BE CONSTRUCTED FROM A SPECIFIC FROM-TO MATRIX
Mark A. Pompetzki and T. H. Topper *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 1 1992 p 53-71 Sponsored by Canadian National Sciences and Engineering Research Council and GKN Technology, Inc. (For primary document see N93-21318 07-39)
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A technique for estimating the most damaging and least damaging histories which can be constructed for a specific from-to matrix is presented. This technique provides an interval within which the damage for the original and reconstructed histories must fall. The upper bound on damage is constructed by maximizing the size of the Rainflow counted strain ranges and positioning each cycle in order to maximize its mean stress. The lower bound on damage results from minimizing the size of the Rainflow counted strain ranges and the mean stresses of the resulting cycles. The results of a damage analysis on the three versions of the Gauss history show that the history representing the lower bound can be significantly different to the reconstructed history or the upper bound. ESA

N93-21322# Ecole Nationale Superieure de Mecanique et d'Aerotechnique, Poitiers (France). Lab. de Mecanique et de Physique des Materiaux.
DAMAGE TOLERANCE OF A HELICOPTER ROTOR HIGH-STRENGTH STEEL
Gilbert Henaff, Jean Petit, and Narayamaswami Ranganathan *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 1 1992 p 73-87 Sponsored by Aerospatiale, Suresnes, France (For primary document see N93-21318 07-39)
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The fatique crack growth behavior of a high strength steel is investigated in air and in vacuum under loading representative of helicopter spectra. The near threshold regime is considered with a high baseline level (R = 0.7). Although strong interaction effects are brought out, non concomitant closure is detected due to the high mean level of the different loading blocks. A model of the observed retardation phenomenon, which incorporates crack growth laws previously developed to describe the influence of environment, is proposed. The results are in good agreement with experimental data. ESA

N93-21323# Ceskoslovenska Akademie Ved, Brno. Inst. of Physical Metallurgy.
FATIGUE LIFE OF TWO STEELS UNDER VARIABLE AMPLITUDE LOADING
Alois Vasek and Jaroslav Polak *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 1 1992 p 89-98 (For primary document see N93-21318 07-39)
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Smooth cylindrical specimens made from a very low carbon steel and a martensic cast steel were subjected to various loading histories arranged as a sequence of blocks with variable strain amplitudes. The number of blocks to failure were measured as a function of the maximum amplitude in a block. The effect of the ratio of number of lowest and highest amplitudes in a block is studied. The results show that fatigue lives depend strongly on both the maximum amplitude in a block and the relative frequency of the lowest and highest amplitudes in a block. Several fatigue life prediction methods were adopted. The best agreement with experiments is obtained using the methods based on the knowledge of the behavior of short cracks in the materials studied. ESA

N93-21324# ABB Corporate Research, Vaesteraas (Sweden). Applied Mechanics Lab.
SPECTRUM FATIGUE DATA IN COMPARISON TO DESIGN CURVES IN THE LONG LIFE REGIME
Tormod Dahle and Bertil Larsson *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 1 1992 p 99-109 (For primary document see N93-21318 07-39)
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Spectrum fatigue tests in welded steel box beam specimens were run at stress levels giving high cycle fatigue lifes. The test results and current fatigue design codes were compared. The results showed that the codes give unconservative estimations of fatigue lifes by a factor of approximately 4. The same unconservative life estimation was also shown by using a simple fracture mechanics prediction model. New design principles and other models of crack growth in this long life regime are needed. The main conclusion drawn from investigation is that using Palmgren-Miner cumulative damage rule with current design codes can give unwanted too high allowable stresses when the design life typically exceeds 10,000,000 cycles. For safe design, the use of a straight line relation between the stress range and the number of cycles to fracture extended below the constant amplitude fatigue limit, is recommended. ESA

N93-21325# Electricite de France, Clamart. Dept. de Mecanique et Modeles Numeriques.
A MODIFIED MINER RULE TO PREDICT CRACK INITIATION
Said Taheri *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 1 1992 p 111-125 (For primary document see N93-21318 07-39)
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A damage cumulation rule and an upper bound of cumulated damage before propagation are proposed. A linear damage function, linear cumulation in proportional or nonproportional loading in presence of overloading or ratchetting, is used. The effect of prehardening on cyclic stress strain curves is considered and a nonproportional state cyclically equivalent to a uniaxial one is defined. An important difference is shown between a load controlled and a strain controlled experiment for difficult cross slip materials such as 316 stainless steel described by a non stable cyclic stress strain curve. ESA

N93-21326# Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
MODELLING OF FATIGUE CRACK GROWTH IN FLAT PLATE WELDMENTS AND TUBULAR WELDED JOINTS
Grzegorz Glinka and S. Lambert *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 1 1992 p 127-146 (For primary document see N93-21318 07-39)
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Modeling of fatigue crack growth in T-butt plate weldments and tubular joints is discussed. Some of the available stress infinity factor solutions based on the finite element method and the weight function approach are analyzed. It is shown that simultaneous modeling of the fatigue growth of several multiple cracks provides a better simulation of crack shape development than do single crack models; single crack models may be unconservative. The results show that in the case of tubular joints it was necessary to supplement the methodology developed for plate weldments by an additional effect called 'load shedding'. It is believed that the load shedding effect arises due to varying boundary conditions caused by the growing crack. ESA

N93-21327# Mitsubishi Heavy Industries Ltd., Nagasaki (Japan). Research and Development Center.
A LOCAL APPROACH FOR FATIGUE STRENGTH EVALUATION ON SHIP STRUCTURES
Hajime Kawano and Katuaki Inoue *In* Technical Research Centre of Finland, Design Fatigue 1992, Volume 1 1992 p 147-160 (For primary document see N93-21318 07-39)
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A fatigue strength technique estimation is developed. The study is focused on a round fillet joint, and a critical crack configuration, to be used in design steps. In the strength calculation method it is argued how the stress distribution ought to be used in the fatigue assessment of welded joints. Employing an assumed parameter C(r), where r is the distance from toe of weld reinforcement, the fatigue test data is analyzed. It is found that the C(r) value could commonly apply in these instances within about 5 mm from the weld toe. It therefore was decided that the local stress at 5 mm from the weld toe would be appropriate for practical use as reference stress to estimate the fatigue strength of round fillet weld. The results show that: fatigue crack initiation occurs in considerably early stage compared with failure life; to make the allowable crack configuration clear and significant in practical use it seems to be appropriate to include the track propagation life; the local stress at 5 mm away from the toe of round fillet weld would be appropriate. ESA

N93-21328# Witwatersrand Univ., Johannesburg (South Africa). Dept. of Metallurgy and Materials Engineering.

FATIGUE LIFE PREDICTION FOR 6261-T6 ALUMINIUM ALLOY I-BEAMS WITH WELDED COVER PLATES

M. Neil James, H. O. Lambrecht, and A. E. Paterson (Aluminum Federation of South Africa, Isando.) *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 1 1992 p 161-179 (For primary document see N93-21318 07-39)

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The fatigue strength data were acquired in bend from some 50 extruded 6261 aluminum alloy I-beams with cover plates welded to them. The cover plates were rectangular, oval or rhomboid in shape with either welded or unwelded transverse ends. The data from stress range versus number of cycles diagrams (S-N diagrams) were compared with design curves from British Standard (BS) CP 118 : 1969 and BS 8118 Part 1 : 1991. An S-N diagram element analysis of a model cover plate/I beam geometry was linked with other growth rate data, to provide a life prediction S-N curve a Paris law integration. Good agreement was found between the results from the model and the experimental data. ESA

N93-21329# Deutsche Reichsbahn, Brandenburg-Kirchmoeser (Germany). Zentralstelle Umweltschutz und Materialpruefung.

FRACTURE-MECHANICAL ANALYSIS OF THE RESIDUAL SERVICE LIFE OF THE WELDED MAIN GIRDERS OF THE HIGHWAY BRIDGES OF RUEDERSDORF

Karl-Otto Edel *In* Technical Research Centre of Finland, Design Fatigue 1992, Volume 1 1992 p 181-195 (For primary document see N93-21318 07-39)

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A fracture mechanics analysis was carried out on a certain type of weld defect contained in the main girders of the Ruedersdorf highway bridges (River Luehlen, Germany). To assess fatigue cracks which start from welding defects of about 10 mm height at the end of the inner cover plates, specimens were taken from the bridges. The fracture mechanical properties of the 55 years old steel and the stress intensity factors were determined to analyze the unstable and stable crack extension. The essential influence on the residual life is the extending traffic density. The assesssment of the critical crack size and that of the crack growth show a residual service life of some years. Only limited data can be generated from specimens removed from the bridges, and the effect of the service environment of any specific structure must be taken into account. ESA

N93-21330# Universidad de Santander (Spain). Materials Science Div.

FATIGUE OF OLD METALLIC RAILROAD BRIDGES

Jose Maria Varona, Federico Gutierrez-Solana, and Javier J. Gonzalez *In* Technical Research Centre of Finland, Design Fatigue 1992, Volume 1 1992 p 197-213 (For primary document see N93-21318 07-39)

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The fatigue behavior of materials taken from old metallic railroad bridges are investigated as a prerequisite to determine their residual life. Following an appropriate methodology for the characterization in fatigue of these materials, carbon steels and puddle irons, their S-N Woehler curves were obtained. These curves are analyzed according to the European standards and recommendations on fatigue design of steel structures. The work was completed with the characterization of the behavior of welded joints. The most important conclusion is the relevant influence of the surface defects present in the material on its fatigue behavior. The presence of these defects conditions the process of obtaining samples from the bridges to be analyzed. These samples have to include the surface defects to be representative. ESA

N93-21331# Lulea Univ. (Sweden). Solid Mechanics Div.

FATIGUE LIFE ASSESSMENT OF SERVICE DAMAGED AND CORRODED MEMBERS OF STRUCTURAL STEEL

Kjell Eriksson *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 1 1992 p 215-227 Sponsored by Swedish National Rail Administration (For primary document see N93-21318 07-39)

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A method for estimating the residual fatigue life of service damaged and corroded structural members are developed. Scratch and hit marks, misplaced or empty holes that are exposed to corrosion are considered. The method is based on Palmgren-Miner's damage accumulation rule and field registered stress collectives. Standard methods are used to take effects of stress concentration and corrosion into account. If stress concentration and corrosion combine as is usually assumed, then corroded scratch marks may affect residual life. ESA

N93-21332# Academy of Sciences (USSR), Leningrad. Mechanical Engineering Research Inst.

A COMPARATIVE STUDY OF SHIP HULL STRUCTURES FATIGUE ASSESSMENT METHODS

Sergei V. Petinov, Helena A. Polezhayeva, and Natalya S. Yermolayeva *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 1 1992 p 229-244 (For primary document see N93-21318 07-39)

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Several methods of fatigue assessment in ship hull structures are compared. The analysis is focused on fatigue problems of hull structures concerning: evaluation, the design state of fatigue damage of a structure formulation, and the adequacy of methods and data bases for the purpose of the analyses. To illustrate the discussion, examples of allowable nominal stress at a given fatigue life calculation are presented for bottom frame web slot and for a bottom longitudinal transverse bulkhead bracket connection in the case of a container ship. The low cycle (local strain) method is regarded as the most advantageous at present almost in all practical problems connected to fatigue. ESA

N93-21333# Peugeot S.A., Bievres (France).

FOR A BETTER FATIGUE STRENGTH OF WELDED STEEL STRUCTURES

Andre Bignonnet *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 1 1992 p 245-265 (For primary document see N93-21318 07-39)

Copyright Avail: CASI HC A03/MF A03

Different postweld improvement techniques and their potential for improving fatigue strength are reviewed. All these techniques are used to delay crack initiation for as long as possible. The most effective method consists of decreasing local stress in welded areas, either through geometric modification or by including favorable residual stress in sensitive areas. The techniques discussed are the following: use of special electrodes and improved welding procedures; tungsten inert gas or plasma dressing of the weld toe; weld toe grinding; and hammer and shot peening. The effect of various parameters, especially that of base metal mechanical properties, on fatigue strength is examined. ESA

N93-21334# Nuclear Electric Public Ltd. Co., Gravesend (England). Technology Div.

A COMMENT ON THE ROLE OF MACHINING INDUCED RESIDUAL STRESSES ON FATIGUE CRACK INITIATION

P. Doig and D. Lonsdale *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 1 1992 p 267-278 (For primary document see N93-21318 07-39)

Copyright Avail: CASI HC A03/MF A03

The aim of the study is to determine a criterion for fatigue crack initiation which takes into account the influence of a complex residual stress pattern from mechanical surface finishing processes. This criterion is based on the achievement of a critical combination of mean and cyclic shear stress. The influence of the fatigue limit of a biaxial residual state, including a shear component typical of that developed in the surface by

machine finishing, is considered. The analysis leads to the conclusion that all components of the residual stress tensor introduced by machine finishing contribute to the initiation of fatigue cracking. ESA

N93-21335# Nagaoka Technological Univ., Niigata (Japan).
EFFECT OF COATING-LAYER THICKNESS ON HIGH TEMPERATURE FATIGUE STRENGTH IN THERMAL-BARRIER-COATED STEEL
Yoshiharu Mutoh and Masaaki Takeuchi (Honda, United Kingdom Mfg. Ltd., Swindon, England.) *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 1 1992 p 279-293 (For primary document see N93-21318 07-39)
Copyright Avail: CASI HC A03/MF A03

The fatigue performance of ZrO2 plasma spray coated structural steel, at room temperature and at 773 K, is assessed. Fatigue strengths of ceramic coated steel at both temperatures were almost identical. Fatigue strength of the specimen with a thick ceramic coating layer was higher than that with a thin ceramic coating layer. These results are conceivable, considering that thickness of the ceramic layer corresponds to an initial defect size. ESA

N93-21336# Huazhong Univ. of Science and Technology, Wuhan (China). Dept. of Mechanics.
THE IMPROVEMENT OF FATIGUE LIFE OF ALUMINUM ALLOY STRUCTURE BY LASER RADIATION
Zhixiong Qian, Changchun Li, and Guangxia Li *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 1 1992 p 295-301 (For primary document see N93-21318 07-39)
Copyright Avail: CASI HC A02/MF A03

The influence of laser radiation in the fatigue life of aluminum alloy structures is investigated. The fatigue life of metal structures depends on its surface conditions: the surface of a metal is usually the source of its fatigue crack and damage. The experiment results show that by taking values within a definite range of the laser radiation parameters, laser radiation could improve the fatigue life of the structure efficiently, and the fatigue failure spot on the radiated structure changes its position. Experiment data showed that the ratio of the medium value fatigue life of radiated structures to that of irradiated ones is 1.67 to 4.40. ESA

N93-21337# Kernforschungszentrum G.m.b.H., Karlsruhe (Germany). Inst. fuer Materialforschung 2.
FINDING FATIGUE RESISTANT AND LIGHTWEIGHT DESIGNS USING THE OPTIMIZATION METHODS CAO AND SKO
C. Mattheck, Frank Walther, and A. Baumgartner *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 1 1992 p 303-312 (For primary document see N93-21318 07-39)
Copyright Avail: CASI HC A02/MF A03

Computer Aided Optimization (CAO), a new method of shape optimization based on the computer simulation of biological growth and Soft Kill Option (SKO), and a strategy to find new design solutions with reduced weight are presented. CAO is used to improve the design of technical components by gaining a homogenized stress distribution on the surface of two and three dimensional finite element models. SKO helps to define new topologies starting from a general oversized 'design area'. With CAO it is also possible to simulate the 'adaptive growth' of biological load carriers, while SKO simulates the mineralization process of bones adapted to their loading. The main ideas of the methods are outlined and several examples of optimizations are shown. If completely new solutions for technical problems are desired, SKO is used first and the design proposal being found is then optimized by CAO in order to achieve a lightweight and fatigue resistant design. The efficiency of the combination of the two methods as a complete layout procedure is shown. ESA

N93-21338# ABB Corporate Research, Baden (Switzerland). Power Generation.
SIMPLIFIED ANALYSIS OF ELASTIC-PLASTIC STRAIN CONCENTRATION IN NOTCHED COMPONENTS UNDER CYCLIC LOADING
Gunnar Haerkegaard and Svein Stubstad (Norges Tekniske Hoegskole, Trondheim.) *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 1 1992 p 313-330 (For primary document see N93-21318 07-39)
Copyright Avail: CASI HC A03/MF A03

Methods for simplified elastic plastic analysis of notched components, based on linearly elastic solutions are reviewed. Elastic and elastic-plastic finite element analyses were carried out for several three dimensional configurations: a plate of variable thickness with a circular 90 degrees through hole under uniform, uniaxial tension; a thick plate with a circular 90 degrees through hole under bending; and a thick plate with a circular 45 degrees through hole under uniform, uniaxial tension. The application of computational results to the prediction of fatigue life of notched components was demonstrated. ESA

N93-21339# Health and Safety Executive, Bootle (England).
MULTI-AXIAL FATIGUE DAMAGE ANALYSIS USING THE BOUNDARY ELEMENT METHOD
Thomas Hinks and Ali El-Zafrany (Cranfield Inst. of Tech., Bedford, England.) *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 1 1992 p 331-350 (For primary document see N93-21318 07-39)
Copyright Avail: CASI HC A03/MF A03

Methods of multiaxial fatigue damage analysis are reviewed. The attention is focussed on analysis by crack initiation, and by crack growth for both constant and variable amplitude loading based upon the boundary element method. An efficient numerical algorithm for the evaluation of stress intensity factors, based upon the J integral parameter, is developed and employed for fatigue crack analysis. Case studies are analyzed and employed in the validation and assessment of the developed theory and programming package. It is proved that the boundary element method is more accurate and facilitates enormous saving in modeling time and data preparation as compared to the finite element method. It is also very efficient for the analysis of multiaxial fatigue problems involving either crack initiation or crack growth. ESA

N93-21340# Tulsa Univ., OK. Dept. of Mechanical Engineering.
THE USE OF FINITE ELEMENT CODES FOR CYCLIC STRESS-STRAIN ANALYSIS
James R. Sorem, Jr. and Steven M. Tipton *In* Technical Research Centre of Finland, Fatigue Design 1992, Volume 1 1992 p 351-367 (For primary document see N93-21318 07-39)
Copyright Avail: CASI HC A03/MF A03

Commercial finite element codes are used to describe elastic-plastic states of stress-strain at structural discontinuities. Several pitfalls that may be encountered when such codes are utilized for cyclic loading situations are demonstrated. A number of simple cyclic loading cases are analyzed to demonstrate the conflicting results that can ensue, based on which plasticity option is utilized. Other factors that can contribute to analytical uncertainty pertaining to the Bauschinger effect are addressed. The use of monotonic versus cyclic constitutive relations is shown. ESA

N93-21366*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
THE BEHAVIOR OF ELASTIC ANISOTROPIC LAMINATED COMPOSITE FLAT STRUCTURES SUBJECTED TO DETERMINISTIC AND RANDOM LOADINGS Technical Report, 1 Jul. 1987 - 20 Jun. 1990
Liviu Librescu 19 Jun. 1990 13 p
(Grant NAG1-749)
(NASA-CR-192197; NAS 1.26:192197) Avail: CASI HC A03/MF A01

Within this research project, the following topics were studied: (1) foundation of the refined theory of flat cross-ply laminated composite flat and curved panels as well as their static and dynamic response analysis; (2) foundation of a geometrically-nonlinear shear-deformable theory of composite laminated flat panels including the effect of initial geometric imperfections and its application in the postbuckling analysis; (3) the study of the dynamic response of shear deformable elastic laminated composite panels to deterministic time-dependent external excitations as the sonic boom and explosive blast type-loadings; (4) the study of the dynamic response of shear deformable elastic laminated composite panels to random excitation as e.g. the one produced by a jet noise or by any time-dependent external excitation whose characteristics are expressed in a statistical sense; and (5) the dynamic stability of fiber-reinforced composite flat panels whose materials (due to e.g. an ambient high temperature field) exhibit a time-dependent physical behavior. Author

N93-21484# Sandia National Labs., Albuquerque, NM.
A COMPARISON OF FORCE RECONSTRUCTION METHODS FOR A LUMPED MASS BEAM
V. I. Bateman, R. L. Mayes, and T. G. Carne 1992 12 p Presented at the 63rd Shock and Vibration Symposium, Las Cruces, NM, 27 Oct. 1992
(Contract DE-AC04-76DP-00789)
(DE93-002461; SAND-92-1429C; CONF-9210176-4) Avail: CASI HC A03/MF A01

Two extensions of the force reconstruction method, the Sum of Weighted Accelerations Technique (SWAT), are presented; and the results are compared to those obtained using SWAT. SWAT requires the use of the structure's elastic mode shapes for reconstruction of the applied force. Although based on the same theory, the two new techniques do not rely on mode shapes to reconstruct the applied force and may be applied to structures whose mode shapes are not available. One technique uses the measured force and acceleration responses with the rigid body mode shapes to calculate the scalar weighting vector, so the technique is called SWAT-CAL (SWAT using a CALibrated force input). The second technique uses only the free-decay time response of the structure with the rigid body mode shapes to calculate the scalar weighting vector and is called SWAT-TEEM (SWAT using Time Eliminated Elastic Modes). DOE

N93-21499# SRI International Corp., Menlo Park, CA.
APPLICATION OF NEW EXPERIMENTAL METHODS TO PIPELINE STRESS CORROSION CRACKING Annual Report, Mar. 1991 - Feb. 1992
C. G. Schmidt, T. Kobayashi, J. E. Crocker, C. H. Kanazawa, and J. A. Kempf Jul. 1992 67 p
(Contract GRI-5091-260-2119)
(PB92-224575; GRI-91/0268) Avail: CASI HC A04/MF A01

The objective of the investigation is to develop a physically based understanding of the mechanisms of stress corrosion cracking (SCC) in pipeline steels by applying advanced fracture surface and electrochemical characterization techniques to samples taken from fielded pipeline and to laboratory corrosion test specimens. SCC is a well-known concern of the gas industry that occasionally affects natural gas treatment plants, gathering lines, and transmission lines. The research program is designed to increase the understanding of pipeline degradation by identifying the specific mechanisms that control SCC. From the results, the authors expect to improve the ability to identify features in the metallurgy of pipeline steel, the environmental conditions that affect the susceptibility to SCC. The effect of overloads (possibly from hydrotests or pressure fluctuations) on the propagation of stress corrosion cracks was readily evident from an analysis of the topographies of conjugate fracture surfaces. Crack branching usually resulted from overloads. Corrosion products were removed from the fracture surfaces of a stress corrosion crack in a pipeline specimen recovered from service. The topography of the underlying metal surface appears to be preserved with little corrosion damage after crack formation. This allowed the cracking process to be reconstructed and details to be investigated. GRA

N93-21565 National Physical Lab., Teddington (England). Materials Metrology Div.
CREEP LABORATORY MANUAL
S. Osgerby, ed. and M. S. Loveday, ed. Jun. 1992 99 p
(NPL-DMM(A)-37; ETN-93-93061) Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

A manual for the NPL Creep Laboratory, a collective name given to two testing laboratories, the Uniaxial Creep Laboratory and the Advanced High Temperature Mechanical Testing Laboratory, is presented. The first laboratory is devoted to uniaxial creep testing and houses approximately 50 high sensitivity creep machines including 10 constant stress cam lever machines. The second laboratory houses a low cycle fatigue testing machine of 100 kN capacity driven by a servo-electric actuator, five machines for uniaxial tensile creep testing of engineering ceramics at temperatures up to 1600C, and an electronic creep machine. Details of the operational procedures for carrying out uniaxial creep testing are given. Calibration procedures to be followed in order to comply with the specifications laid down by British standards, and to provide traceability back to the primary standards are described. ESA

N93-21566 National Physical Lab., Teddington (England). Materials Metrology Div.
REVIEW OF MODELLING OF ENVIRONMENT-ASSISTED CRACKING
A. Turnbull May 1992 65 p Sponsored by Dept. of Trade and Industry
(NPL-DMM(A)-44; ETN-93-93062) Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

A critical evaluation of mechanistically based modeling of environment assisted cracking was made. Models based on anodic reaction, namely slip dissolution, anodic reaction induced cleavage, and surface mobility are evaluated from both a mechanistic and quantitative perspective. Models of cracking based primarily on the effect of hydrogen atoms are also evaluated. The kinetics of generation and absorption of hydrogen atoms, and the transport and localization of hydrogen atoms in metals, are discussed. Different mechanisms of hydrogen embrittlement concerning the following are discussed: pressure theory, surface energy, hydrogen attack, hydrogen related phase change mechanisms, hydrogen enhanced local plasticity, and hydrogen effects on the cohesive energy. Quantitative modeling of hydrogen cracking is assessed. ESA

N93-21689# Sydney Univ. (Australia). School of Civil and Mining Engineering.
THEORETICAL ANALYSIS OF PLASTIC MOMENT CAPACITY OF AN INCLINED YIELD LINE UNDER AXIAL FORCE Research Report
Xiao-Ling Zhao and Gregory J. Hancock Feb. 1992 39 p
(PB93-118784; R-648) Avail: CASI HC A03/MF A01

Existing formulae for reduced plastic moment capacity of an inclined yield line under axial force are reviewed. Lower bound solutions, which are based on the Tresca yield criterion and the von Mises yield criterion, are derived to determine the reduced plastic moment capacity of an inclined yield line under axial force. The effect of the twisting moment on the reduction of the plastic moment capacity is considered. GRA

N93-21711# Sandia National Labs., Albuquerque, NM.
FATIGUE OF FIBERGLASS WIND TURBINE BLADE MATERIALS
J. F. Mandell (Montana State Univ., Bozeman.), R. M. Reed (Montana State Univ., Bozeman.), and D. D. Samborsky (Montana State Univ., Bozeman.) Aug. 1992 61 p
(Contract DE-AC04-76DP-00789)
(DE93-005381; SAND-92-7005) Avail: CASI HC A04/MF A01

Fatigue behavior for a variety of generic materials used in wind turbine blades was explored. Coupon testing was carried out under constant amplitude tensile fatigue loading to beyond 10(exp 7) cycles for most materials. Unidirectional materials performed close to expectations despite fiber misalignment. Materials with triaxial (0/plus or minus 45) reinforcement showed greater fatigue sensitivity than expected, but lifetime trends flattened at high cycles. The uniaxial and triaxial materials could be normalized to a single S-N lifetime trend for each case. Results include the effects of differing matrix materials, manufacturing methods, reinforcement structure, and ply terminations. DOE

N93-21774# Westinghouse Hanford Co., Richland, WA.
IMPROVING THE SELECTION OF BOLTED JOINT PARAMETERS BY USING RESULTS FROM FINITE-ELEMENT ANALYSIS
H. H. Ziada Oct. 1992 24 p Presented at the 1993 American Society of Mechanical Engineers (ASME) National Design Engineering Conference, Chicago, IL, 7-11 Mar. 1993
(Contract DE-AC06-87RL-10930)
(DE93-002243; WHC-SA-1606; CONF-930361-1) Avail: CASI HC A03/MF A01

Finite-element techniques were used to determine the combination of parameters that would produce the optimum design for the bolted joint. A finite-element model was constructed from a combination of two-dimensional isoparametric axisymmetric solid elements and gap elements. The gap elements represented the physical contact between the plate and bolt head and the plate and nut. The model was used to determine the stress patterns, displacements, and contact areas (separation diameters) across the bolted joint. Computed results for the contact area showed the following: the contact area is determined by joint design, not bolt load magnitude; joint thickness, plate thickness ratio, and bolt-head dimensions have a pronounced effect on the contact area; and the maximum contact area occurs with plates of equal thickness. The change in separation diameters

(D) can be presented in a simple straight-line expression D/d = 1 + 1.1 (L/d), where L = joint thickness and d = bolt diameter. The stress results indicated that neither load nor stress distribution under the bolt head or nut is constant or uniform. Bolt-head dimensions, joint thickness, and plate thickness ratio markedly affect the developed stresses, with the maximum stress value occurring at the bolt-plate interface. Beyond the bolt head, maximum stress develops at the interface plane of the bolted plates, with that stress decreasing as the plate thickness ratio increases reaching its lowest value at the equal-thickness ratio. These results indicate that design stiffness formulas used heretofore are not adequate. Results provided by this analysis should prove more effective in achieving optimum bolt design for bolted joints. DOE

N93-21798# Sydney Univ. (Australia). School of Civil and Mining Engineering.

EXPERIMENTAL VERIFICATION OF THE THEORY OF PLASTIC MOMENT CAPACITY OF AN INCLINED YIELD LINE UNDER AXIAL FORCE

Xiao-Ling Zhao and Gregory J. Hancock Feb. 1992 81 p

(PB93-118792; R-649) Avail: CASI HC A05/MF A01

A series of experimental tests on plastic hinges under axial force have been performed, where the inclination angles (beta) of the yield line relative to a line perpendicular to the direction of the axial force are chosen as 0, 15, 30, 45, and 60 degrees. The fomulate derived by Zhaoand Hancock (1992) for the moment capacity of an inclined yield line under axial force are verified experimentally. Simplified expressions for the Chao and Hancock formulae are also given to permit easy application of the theory. GRA

N93-21831*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

APPLICATION OF ARTIFICIAL NEURAL NETWORKS TO THE DESIGN OPTIMIZATION OF AEROSPACE STRUCTURAL COMPONENTS

Laszlo Berke, Surya N. Patnaik (Ohio Aerospace Inst., Brook Park.), and Pappu L. N. Murthy Mar. 1993 13 p

(RTOP 505-63-5B)

(NASA-TM-4389; E-6994-1; NAS 1.15:4389) Avail: CASI HC A03/MF A01

The application of artificial neural networks to capture structural design expertise is demonstrated. The principal advantage of a trained neural network is that it requires trivial computational effort to produce an acceptable new design. For the class of problems addressed, the development of a conventional expert system would be extremely difficult. In the present effort, a structural optimization code with multiple nonlinear programming algorithms and an artificial neural network code NETS were used. A set of optimum designs for a ring and two aircraft wings for static and dynamic constraints were generated by using the optimization codes. The optimum design data were processed to obtain input and output pairs, which were used to develop a trained artificial neural network with the code NETS. Optimum designs for new design conditions were predicted by using the trained network. Neural net prediction of optimum designs was found to be satisfactory for most of the output design parameters. However, results from the present study indicate that caution must be exercised to ensure that all design variables are within selected error bounds. Author

N93-21839# Department of Energy, Washington, DC.

ENVIRONMENTAL ASSESSMENT FOR THE BRILLIANT PEBBLES TETHER TEST AT THE NEVADA TEST SITE

Apr. 1992 28 p

(DE93-003869; DOE/EA-0621) Avail: CASI HC A03/MF A01

Lawrence Livermore National Laboratory (LLNL) proposes to conduct a captive flight test of a prototype Brilliant Pebble (BP) at the Nevada Test Site (NTS). A Brilliant Pebble is a small, maneuverable, rocket powered, laser-equipped vehicle being designed to detect, track, and intercept ballistic missiles. The tests described in this Environmental Assessment would allow the vehicle to be tested at the earth's surface, before the more expensive tests in space take place. To simulate the zero gravity conditions found in space, the BP vehicle would be hung from a very high tower, allowing the vehicle to maneuver freely in the horizontal plane. To simulate tracking and interception, a way to produce rapidly approaching laser light reflections must be devised. The proposed action is to install a long line of shuttered reflectors, which would be capable of opening and closing extremely rapidly under remote control. These reflectors would be installed in a straight line leading toward, but not exactly at, the BP hanging from the tower. These reflectors would then be opened and shut in a very rapid sequence, beginning at the far end. As the BP's laser touched the sequence of opening reflectors, the return signals would appear to the BP to be the reflections from a rapidly approaching 'target'. An on-board computer would then calculate the speed and (apparent) trajectory of the 'target', as indicated by the reflected light signals. The computer would then direct the rocket motors to fire in a specific direction to intercept the 'target' as it approached the tower. The sequence of increasingly complex tasks required to suppose this test are described along with an analysis of potential environmental, health, and safety effects. DOE

N93-21987# Army Armament Research, Development and Engineering Center, Watervliet, NY. Benet Lab.

THE EFFECTS OF SURFACE TREATMENT ON TORSIONAL FATIGUE FAILURE IN RECOIL SPRINGS Final Report

R. R. Fujczak, J. A. Kapp, and C. J. Nolan Oct. 1992 31 p

(AD-A259345; ARCCB-TR-92045) Avail: CASI HC A03/MF A01

Two different steels, AISI 4150H and maraging 250, were tested in torsional fatigue to failure. Both materials were prepared with three surface conditions: (1) as-machined (machining grooves left on the outside surface); (2) as-polished; and (3) polished and shot peened. All specimens converge at low cycle life (about 1,000 cycles), but at lower torsional stresses, the greatest improvement in fatigue life is shown by the shot peened specimens, foliowed by the as-polished specimens. This is true for both materials. The 4150H steel shows the greatest fatigue lives on the torsional S-N curves, but the maraging 250 displays the greatest degree of improvement throughout the range of surface conditions. GRA

N93-21992# Tennessee Univ., Knoxville. Dept. of Nuclear Engineering.

VIBRATION MONITORING WITH ARTIFICIAL NEURAL NETWORKS

I. Alguindigue and R. E. Uhrig 1991 13 p Presented at the 6th Specialists Meeting on Reactor Noise, Gatlinburg, TN, 19-24 May 1991

(Contracts DE-FG07-88ER-12824; DE-AC05-84OR-21400)

(DE93-003543; CONF-910535-6) Avail: CASI HC A03/MF A01

Vibration monitoring of components in nuclear power plants has been used for a number of years. This technique involves the analysis of vibration data coming from vital components of the plant to detect features which reflect the operational state of machinery. The analysis leads to the identification of potential failures and their causes, and makes it possible to perform efficient preventive maintenance. Early detection is important because it can decrease the probability of catastrophic failures, reduce forced outgage, maximize utilization of available assets, increase the life of the plant, and reduce maintenance costs. This paper documents our work on the design of a vibration monitoring methodology based on neural network technology. This technology provides an attractive complement to traditional vibration analysis because of the potential of neural network to operate in real-time mode and to handle data which may be distorted or noisy. Our efforts have been concentrated on the analysis and classification of vibration signatures collected from operating machinery. Two neural networks algorithms were used in our project: the Recirculation algorithm for data compression and the Backpropagation algorithm to perform the actual classification of the patterns. Although this project is in the early stages of development it indicates that neural networks may provide a viable methodology for monitoring and diagnostics of vibrating components. Our results to date are very encouraging. DOE

N93-21993# Tennessee Univ., Knoxville. Dept. of Nuclear Engineering.

VIBRATION MONITORING OF EDF ROTATING MACHINERY USING ARTIFICIAL NEURAL NETWORKS

I. E. Alguindigue, A. Loskiewicz-Buczak, R. E. Uhrig, L. Hamon, and F. Lefevre 1991 12 p Presented at the International Conference on Frontiers in Innovative Computing for the Nuclear Industry, Jackson, WY, 15-18 Sep. 1991

(Contract DE-FG07-88ER-12824)

(DE93-003557; CONF-9109110-14) Avail: CASI HC A03/MF A01

Vibration monitoring of components in nuclear power plants has been used for a number of years. This technique involves the analysis of vibration data coming from vital components of the plant to detect features which reflect the operational state of machinery. The analysis leads to the identification of potential failures and their causes, and makes it possible to perform efficient preventive maintenance. Early detection is important

because it can decrease the probability of catastrophic failures, reduce forced outgage, maximize utilization of available assets, increase the life of the plant, and reduce maintenance costs. This paper documents our work on the design of a vibration monitoring methodology based on neural network technology. This technology provides an attractive complement to traditional vibration analysis because of the potential of neural networks to operate in real-time mode and to handle data which may be distorted or noisy. Our efforts have been concentrated on the analysis and classification of vibration signatures collected by Electricite de France (EDF). Two neural networks algorithms were used in our project: the Recirculation algorithm and the Backpropagation algorithm. Although this project is in the early stages of development it indicates that neural networks may provide a viable methodology for monitoring and diagnostics of vibrating components. Our results are very encouraging. DOE

N93-21994# Oak Ridge National Lab., TN.
THE HIGH TEMPERATURE MATERIALS LABORATORY: A RESEARCH AND USER FACILITY AT THE OAK RIDGE NATIONAL LABORATORY
1992 57 p
(Contract DE-AC05-84OR-21400)
(DE93-003592; ORNL/M-1741) Avail: CASI HC A04/MF A01

HTML is a modern facility for high-temperature ceramic research; it is also a major user facility, providing industry and university communities access to special research equipment for studying microstructure and microchemistry of materials. User research equipment is divided among six User Centers: Materials Analysis, X-ray Diffraction, Physical Properties, Mechanical Properties, Ceramic Specimen Preparation, and Residual Stress. This brochure provides brief descriptions of each of the major research instruments in the User Centers: scanning Auger microprobe, field emission SEMs, electron microprobe, multitechnique surface analyzer, analytical electron microscope, HRTEM, optical microscopy & image analysis, goniometer, scanning calorimetry, simultaneous thermal analysis, thermal properties (expansion, diffusivity, conductivity), high-temperature tensile test facilities, flexure, electromechanical test facilities (flexure, compression creep, environmental), microhardness microprobe, ceramic machining. Hands-on operation by qualified users is encouraged; staff is available. Both proprietary and nonproprietary research may be performed. Proprietary research is one on a full-cost recovery basis. DOE

N93-22005*# United Technologies Corp., East Hartford, CT.
STRUCTURAL TAILORING OF ADVANCED TURBOPROPS (STAT). THEORETICAL MANUAL
K. W. Brown Oct. 1992 79 p
(Contract NAS3-23941)
(NASA-CR-191017; NAS 1.26:191017; PWA-5767-109) Avail: CASI HC A05/MF A01

This manual describes the theories in the Structural Tailoring of Advanced Turboprops (STAT) computer program, which was developed to perform numerical optimizations on highly swept propfan blades. The optimization procedure seeks to minimize an objective function, defined as either direct operating cost or aeroelastic differences between a blade and its scaled model, by tuning internal and external geometry variables that must satisfy realistic blade design constraints. The STAT analyses include an aerodynamic efficiency evaluation, a finite element stress and vibration analysis, an acoustic analysis, a flutter analysis, and a once-per-revolution (1-p) forced response life prediction capability. The STAT constraints include blade stresses, blade resonances, flutter, tip displacements, and a 1-P forced response life fraction. The STAT variables include all blade internal and external geometry parameters needed to define a composite material blade. The STAT objective function is dependent upon a blade baseline definition which the user supplies to describe a current blade design for cost optimization or for the tailoring of an aeroelastic scale model. Author

42 GEOSCIENCES (GENERAL)

N93-21569# European Space Agency, Paris (France).
ENVIRONMENT OBSERVATION AND CLIMATE MODELLING THROUGH INTERNATIONAL SPACE PROJECTS. VOLUME 1: REMOTE SENSING FOR GLOBAL CHANGE, CLIMATE CHANGE AND ATMOSPHERE AND OCEAN FORECASTING
T. Duc Guyenne, ed. and James J. Hunt, ed. 1992 409 p Conference held in Munich, Germany, 30 Mar. - 4 Apr. 1992; sponsored by EEC, ESA, Deutsche Agentur fuer Raumfahrtangelegenheiten, and the European Association for the International Space Year
(ESA-ISY-1-Vol-1; ETN-93-93502) Copyright Avail: CASI HC A18/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The European International Space Year conference was held with the specific theme of the practical use of space derived information for environmental research and monitoring, and resource management. This main theme, 'Mission to Planet Earth', was maintained, but it was recognized that other fields needed to be equally addressed to provide a balanced view on space activities. Space sciences, space navigation and communications, and manned space activities were also represented. The present volume consists of papers addressing: remote sensing for global change; remote sensing for climate change; and remote sensing for atmosphere and ocean forecasting. For individual titles, see N93-21570 through N93-21641.

N93-21570# Commonwealth Scientific and Industrial Research Organization, Alice Springs (Australia). Wildlife and Ecology Div.
GLOBAL MODELS OF ECOSYSTEM CHANGE Status Report **c45**
B. H. Walker *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 3-7 (For primary document see N93-21569 07-42)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

The prediction of changes in vegetation and the interaction of ecosystems with the atmosphere is assessed. Global vegetation models are of five main kinds. Four of them (correlative, plant ecophysiological, functional type dominance, and the gap phase or plant by plant replacement models) are based either on some topology of vegetation or on species composition. Using them for climate feedback effects requires an intermediate set up to transform vegetation type into a set of functional attributes (albedo, etc.). The fifth approach is to directly model the functional attributes, using vegetation structure as the main predictor. The various approaches need to be brought together in a dynamic global vegetation model. ESA

N93-21571# Freie Univ., Berlin (Germany). Inst. fuer Meteorologie.
END-TO-END TESTS OF SATELLITE DATA **c43**
H. Billing, H.-J. Bolle, and M. Eckardt *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 9-12 (For primary document see N93-21569 07-42)
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Surface reflectances measured during a campaign in the Republic of Niger (Africa), are compared to TM (Thematic Mapper) data. It is shown, that the atmospheric correction can be parameterized as a nearly linear dependence between surface and planetary albedo. The model parameters for the radiative transfer model are taken from a nearby radiosonde ascent. The optical depth is adjusted with the parameters visibility and wind speed to fit the measured values. The diffuse radiation is also compared with the model calculations. TM data with atmospheric correction show a reasonable agreement with ground measured values for vegetated and unvegetated surfaces. ESA

N93-21572# National Environmental Research Council, Reading (England). Remote Sensing Applications Development Unit.
EARTH OBSERVATION IN THE TIGER PROGRAMME OF THE UK NATURAL ENVIRONMENT RESEARCH COUNCIL **c45**
S. A. Briggs *In* ESA, Environment Observation and Climate Modelling

Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 13-17 (For primary document see N93-21569 07-42)

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The Terrestrial Initiative in Global Environment Research (TIGER) European Community research program, concerned with the terrestrial environment and climate change, is described. The mission of the TIGER program is to create a better understanding of processes in the biosphere so that causes and consequences of climate change can be foreseen and forestalled. TIGER has four main themes: the carbon cycle on land; to trace greenhouse gases; water and energy balance; and impacts of climate change on ecosystems. The capability of remote sensing to deliver synoptic measurements of parameters relevant to surface processes over a regional scale ensures that it is a major contributor in the methodology of the program. Specific areas which are addressed by remotely sensed means within the above themes include study of the role of tropical forests in the carbon cycle, scaling up of local measures of energy, water and momentum exchange, understanding of the role of vegetation cover in radiative forcing and study of the impact of climate change on the land surface at a regional scale and above. ESA

N93-21573# Joint Research Centre of the European Communities, Ispra (Italy). Remote Sensing Applications Inst.

PREPARATION OF AVHRR GAC DATA SETS FOR GLOBAL CHANGE STUDIES **c45**

A. S. Belward, J. V. Vogt, A. Falk-Langemann (Gesellschaft fuer Angewandte Fernerkundung, Munich, Germany.), S. Saradeth (Gesellschaft fuer Angewandte Fernerkundung, Munich, Germany.), and H. Cambridge (Serco Space Ltd., Sudbury-on-Thames, England.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 19-23 (For primary document see N93-21569 07-42)

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The design of an Advanced Very High Resolution Radiometer (AVHRR) data base for global climate and environmental studies (global change) is described. The assembly and preprocessing for long term AVHRR Global Area Coverage (GAC) data sets for the African continent is presented. Algorithms for calibration, cloud detection, and geometric correction, are described. The current status of the processing chain is outlined and future developments are discussed. ESA

N93-21574# Freie Univ., Berlin (Germany). Inst. fuer Meteorologie.

THE 8 YEARS MONTHLY VEGETATION INDEX OF CENTRAL EUROPE **c43**

D. Koslowsky, H.-J. Bolle, U. Katergiannakis, D. Praetorius, and W. Tonn *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 25-30 (For primary document see N93-21569 07-42)

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The production of digital maps of the Normalized Difference Vegetation Index (NDVI) of Europe is reported. The area between 40 to 55 deg north and 7 deg west to 17 deg east is processed at 1.2 km resolution. The NDVI maps are compiled by applying the composite technique in order to overcome the cloud problem. The last ten days of each month are used for generating the NDVI. The maximum values which are found for each pixel are mapped into the composite image. With the beginning of the vegetation period 1989 the generation of composites runs automatically. Besides the NDVI the original values of the channels 1 to 5 were stored. This is important for possible later corrections. Each pixel in the composite obtains an indicator for the derivation of the date and the geometric relations. The importance of the storage of these values is shown by two examples for an area in Spain and the island of Fehmarn in the Baltic sea. ESA

N93-21575# Ecole Nationale Superieure de Physique, Strasbourg (France).

EVALUATION OF THE INTERNATIONAL DIRECTORY NETWORK FOR LOCATION OF DATA SETS USEFUL IN GLOBAL VEGETATION CHANGE ASSESSMENT **c43**

R. Thomas and C. Weber (Centre National de la Recherche Scientifique, Strasbourg, France.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 31-36 Sponsored by Univ. Louis Pasteur, CNRS, and International Space Univ. (For primary document see N93-21569 07-42)

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A preliminary evaluation of the International Directory Network (IDN) to determine its usefulness for locating, describing, and accessing space and Earth data sets is reported. The data sets are used for vegetation change assessment in the International Geosphere-Biosphere Program (IGBP). Established through the cooperation of several space agencies, the IDN contains listings and descriptions of data centers, data sets, instruments, projects, and principal investigators related to Earth science, planetary science, space and solar physics, and astronomy. The IDN was found to provide a framework useful for locating data sets and data centers of interest. However, for purposes of regional and global vegetation change studies, the IDN was found to be missing references to in situ data sets of importance in model development and validation. Limitations relative to IDN search effectiveness and utility were identified, together with recommendations for removing these. ESA

N93-21576# Canada Centre for Remote Sensing, Ottawa (Ontario).

INFLUENCE OF TERRAIN ELEVATION ON VEGETATION INDICES DERIVED FROM NOAA AVHRR AND EOS MODIS DATA **c43**

P. M. Teillet, K. Staenz, and J.-F. Parent *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 37-42 (For primary document see N93-21569 07-42)

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Investigation of the influence of atmospheric variations due to terrain elevations in vegetation indices derived from NOAA AVHRR (Advanced Very High Resolution Radiometer) and EOS MODIS (Moderate Resolution Imaging Spectroradiometer) data types is reported. The results indicate that the terrain elevation dependence is significant and increases with decreasing vegetation density. The image simulation in two MODIS-N (Nadir) bands was carried out spectrally and spatially using an AVIRIS (Airborne Visible/Infrared Imaging Spectrometer) data set acquired over mountainous terrain in British Columbia, Canada. ESA

N93-21577# GKSS-Forschungszentrum Geesthacht (Germany).

ESTIMATING CHLOROPHYLL CONCENTRATIONS FROM THEMATIC MAPPER DATA **c43**

Carsten Brockmann *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 43-48 (For primary document see N93-21569 07-42)

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An investigation of the feasibility of using LANDSAT Thematic Mapper (TM) data for measuring ocean color parameters is reported. This involved three main steps: radiometric recalibration, atmospheric correction; and a bio-optical algorithm. Using the three way approach it was shown that TM can be used for estimating the chlorophyll concentration in Case-1 waters. The calibration procedure was developed based on the internal calibration system resulting in more reliable radiance values compared with those derived from the standard ESA calibration. The atmospheric correction can be performed without additional knowledge of the aerosol type and its concentration. During the atmospheric correction procedure, these parameters are calculated from TM data. ESA

N93-21578# Joint Research Centre of the European Communities, Ispra (Italy). Remote Sensing Applications Inst.

MARINE PRODUCTIVITY ALONG THE NORTHWEST COAST OF AFRICA (MAURITANIA): ESTIMATION FROM SATELLITE DATA **c48**

N. Hoepffner, T. Baker, L. VanCamp, L. Nykjaer, P. Schlittenhardt, and C. N. Murray *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 49-54 (For primary document see N93-21569 07-42)

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A spectral model of solar irradiance is combined with a mathematical representation of the photosynthesis light relationship to compute oceanic primary production, which is characterized by a strong upwelling activity, in an area off northwest Africa. The results are shown for different protocols of computation, including the partitioning of the area into several provinces, each of them having a proper set of biological and meteorological parameters. Some examples are given to illustrate the comparison of model results with other studies in the same area. ESA

N93-21579# Academy of Sciences (USSR), Moscow. Scientific Research Center of Ecological Safety.

KEY PROBLEMS OF GLOBAL ECOLOGY AND THE INTERNATIONAL SPACE YEAR **c45**

K. Y. Kondratyev *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 55-56 (For primary document see N93-21569 07-42)

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The principal purpose of the International Space Year (ISY), to stimulate development and application of remote sensing for solving environment problems, is discussed. An attempt is undertaken to substantiate priorities of global ecology and, on the basis of such a substantiation, to consider requirements to observational systems. Optimal spectral channels corresponding to the principle groups of problems, oceanology, hydrology, geology, and forestry and agriculture, are given. A need to work out an adequate program of post-ISY development is mentioned. ESA

N93-21580# Joint Research Centre of the European Communities, Ispra (Italy). Remote Sensing Applications Inst.

MODEL PREDICTIONS OF THE CROSS-SLOPE TRANSPORT OF SHELF ORGANIC CARBON IN THE NORTHWEST AFRICAN UPWELLING ZONE CALIBRATED BY SATELLITE DERIVED PIGMENT FIELDS **c48**

Wolfram Schrimpf, Walter Eifler, and Albert Gabric (Griffith Univ., Nathan, Australia.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 57-63 (For primary document see N93-21569 07-42)

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Mathematical modeling and remote sensed data (CZCS (Coastal Zone Color Scanner)) were jointly applied to study upwelling phenomena and cross shelf transport in the northwest African upwelling zone (study window 23 deg west, 15 deg west/19 deg north, 25 deg north). Three events were investigated for which CZCS time series could be made available (Dec. 83, Mar. 84, and Oct. 84). A three dimensional mathematical model was applied for the simulation of the hydrodynamics on the continental shelf, shelf break, and part of the deep sea. Results from the numerical model are compared with the simplifying Ekman theory for cross shelf transport. The numerical studies were performed for three cross shelf sections (21 deg north, 22.5 deg north, and 24 deg north) in the northwest African upwelling region. The cross shelf transport of organic carbon, was calculated by using CZCS derived particulate carbon concentrations and cross slope volume transport from the numerical model. ESA

N93-21581# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Berlin (Germany). Space Sensor Technology Inst.

CAN MEASUREMENTS IN THE O2A- AND B-BANDS BE USED FOR ATMOSPHERIC CORRECTION OF SATELLITE MEASUREMENTS OVER THE OCEAN? **c43**

B. Pflug, B. Piesik, and G. Zimmermann *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 65-68 (For primary document see N93-21569 07-42)

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A study which shows that ocean surface reflection under typical measuring conditions causes a nonnegligible contribution to the measured total reflectance of the system atmosphere/ocean is presented. Ocean surface reflectance can be evaluated by using measurements in the O2A band around 762 nm. The accuracy is estimated to be of order 10 to 15 percent. This accuracy requires measurement and modeling errors to be less than about 1 percent. At the present state of knowledge, the question of whether B-band measurements are useful for improved atmospheric correction can be fully answered. ESA

N93-21582# Centre de Meteorologie Spatiale, Lannion (France).

VEGETATION COVER MAPPING OVER FRANCE USING NOAA-11/AVHRR **c43**

M. Derrien, B. Farki, H. LeGleau, and A. Sairouni *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 69-73 (For primary document see N93-21569 07-42)

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The processing of NOAA-11/AVHRR (Advanced Very High Resolution Radiometer) data from year 1990 to map the vegetation over France with a 4 km resolution is described. After an automatic cloud detection, Normalized Difference Vegetation Index (NDVI) are computed over the whole period using visible and near infrared reflectances corrected for atmospheric effects. Monthly NDVI values are obtained for each point of the area by keeping the maximum value. The annual profiles are then classified with a clustering algorithm and the resulting classification associated to vegetation cover by comparing with the 1988 vegetation survey from the French Agriculture Department. Nearly all those classes can be qualitatively explained by the percentage of Winter and Summer crops, forest, grassland, and vineyards. ESA

N93-21583# Technical Research Centre of Finland, Espoo. Remote Sensing Section.

ESTIMATION OF CARBON STORAGE AND ORGANIC MATTER IN BOREAL FORESTS USING OPTICAL REMOTE SENSING DATA **c43**

T. Haeme, A. Salli, and K. Lahti *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 75-78 (For primary document see N93-21569 07-42)

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A study to produce a simple method to map the storages of organic matter and carbon in boreal coniferous forests, which form an important pool in the global carbon cycle, is presented. The Normalized Differential Vegetation Index (NDVI), successful for mapping biomass in equatorial regions, does not work at all with coniferous forests. A pilot 'boreal biomass index' based on remote sensing images was developed. The model was successfully tested with both LANDSAT Thematic Mapper (TM), and NOAA AVHRR (Advanced Very High Resolution Radiomer) images. ESA

N93-21584# Mullard Space Science Lab., Dorking (England).

MONITORING WETLAND HYDROLOGY BY REMOTE SENSING: A CASE STUDY OF THE SUDD USING INFRA-RED IMAGERY AND RADAR ALTIMETRY **c43**

I. M. Mason, A. R. Harris, J. N. Moody, C. M. Birkett, W. Cudlip, and D. Vlachogiannis *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 79-84 (For primary document see N93-21569 07-42)

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The difficulties of in situ monitoring of the world's wetlands (important elements of the hydrosphere and biosphere) and the extent to which they

can act as global change indicators are discussed. A case study of the Sudd Marsh in Africa to determine the feasibility of remote sensing of wetland area and level is presented. Accurate area measurements are shown to be feasible using thermal imagery from Meteosat and AVHRR (Advanced Very High Resolution Radiometer) depending on the seasonally variable thermal contrast. Preliminary measurements of water level and extent using Geosat radar altimeter data are presented. These data complement the thermal measurements, and the value of the ERS-1 satellite which carried both types of instrument is noted. It is concluded that there are good prospects for such instruments to carry out long term monitoring of wetlands worldwide. ESA

N93-21585# Lund Univ. (Sweden). Dept. of Physical Geography.
DEFORESTATION IN AFRICAN DRY LANDS: ASSESSMENT OF CHANGES IN WOODY VEGETATION IN SEMI ARID SUDAN **c43**
Lennart Olsson and Jonas Ardoe *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 85-89 (For primary document see N93-21569 07-42)
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The study of one of the most important areas for production of commercial woody biomass in the Sudan (Africa), by means of LANDSAT data from 1973, 1979, and 1987/90 is reported. The main conclusion is that expansion of mechanized rain fed agriculture is the main agent in deforestation. Wood clearing for energy purposes is only a minor agent. Compared with 1973, the cultivated area increased by 265 percent in 1987/90. The area of woodlands was about the same in 1987/90 as in 1973, in spite of the large increase of cultivated area. ESA

N93-21586# Meteorological Office, Bracknell (England). Hadley Centre for Climate Prediction and Research.
SIMULATION OF CLEAR-SKY OUTGOING LONGWAVE RADIATION OVER THE OCEANS USING OPERATIONAL ANALYSES **c43**
A. Slingo and M. J. Webb *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 93-98 (For primary document see N93-21569 07-42)
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A system developed for the simulation and analysis of measurements from satellites using operational analyses (SAMSON) is described. Simulations of clear sky Outgoing Longwave Radiation (OLR) over the oceans are compared with data from the Earth Radiation Budget Experiment (ERBE). The simulations were made with a Malkmus narrowband code, including all the radiatively important trace gases. Sea surface temperatures came fromth e National Meteorological Center (United Kingdom) blended analyses and ozone amounts from Nimbus 7 solar backscatter ultraviolet data. Atmospheric temperatures and humidities came from ECMWF (European Centre for Medium Range Weather Forecasts) and Meteorological Office analyses. The simulated values are within 1 to 10 /sq Wm of those from ERBE. The clear sky OLR can thus be computed from operational analyses with an accuracy comparable with that of the ERBE data. This shows the potential of such simulations and has implications for planning future radiation budget observations. ESA

N93-21587# Bulgarian Academy of Sciences, Sofia. Space Research Inst.
EARTH RADIATION AND CLOUD COVER ANALYSIS USING NOAA SATELLITE DATA **c47**
V. S. Djepa-Petrova, B. I. Madjarov, P. V. Petrov, B. Bancheva, and V. I. Petrov *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 99-103 (For primary document see N93-21569 07-42)
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The possibility of studying the longwave radiation and cloud cover, an important element in climate analysis, by NOAA satellite data is examined. Mathematical models and methods for processing NOAA satellite data are presented. Histogram analysis is used for cloud cover study. The main scientific problems and methods for determination of the Earth surface and atmospheric parameters by satellite data are discussed. Various methods and algorithms for digital processing of NOAA/AVHRR (Advanced Very High Resolution Radiometer) satellite data are presented. The determination of the radiative parameters, albedo, and transmission function of the atmosphere in relation with climate study is examined. The presented mathematical models and methods are used in processing NOAA satellite data for remote sensing and climate research. ESA

N93-21588# Freie Univ., Berlin (Germany). Inst. fuer Meteorologie.
THE INFLUENCE OF HIGH CLOUDS ON CLIMATE **c47**
Franz H. Berger *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 105-109 (For primary document see N93-21569 07-42)
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For several months in 1989-1991, the influence of clouds in climate was determined for two test sites: North Sea and western Mediterranean area. Using satellite data sets (NOAA AVHRR (Advance Very High Resolution Radiometer) and Meteosat), the cloud climate efficiency, a convenient diagnostic cloud climate parameter, was calculated at the top of the atmosphere and at the surface. This efficiency is similar to the cloud forcing, but it defines the influence of an individual classified cloud. The cloud forcing can be calculated as the sum of the cloud climate efficiency over an area. Thus, an important step was also a detailed accurate cloud classification based on the maximum likelihood method. By selecting appropriate thresholds in a two dimensional histogram especially high clouds with different optical depths were classified. To calculate the efficiency at the surface, a computation of cloud optical properties was performed. ESA

N93-21589# Hamburg Univ. (Germany). Meteorologisches Inst.
CLOUD-GENERATED RADIATIVE HEATING DETERMINED FROM SATELLITE MEASUREMENTS **c47**
U. Schmid, E. Raschke (GKSS-Forschungszentrum Geesthacht, Germany.), M. Rieland (Deutscher Bundestag, Bonn, Germany.), and R. Stuhlmann (GKSS-Forschungszentrum Geesthacht, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 111-113 (For primary document see N93-21569 07-42)
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An attempt to estimate the cloud generated radiative heating using the ISCCP (International Satellite Cloud Climatology Project) stage C data is reported. The assumptions made about the cloud structure within a satellite image pixel are shown to have an important influence on the resulting radiative heating. The assumption of complete coverage for the ISCCP cumulus type gives too small geometrical thicknesses. Hence, partly cloudy image pixel have to be assumed with recalculated optical thicknesses which lead to more reasonable geometrical ones. ESA

N93-21590# Hamburg Univ. (Germany). Meteorologisches Inst.
ESTIMATING THE VERTICAL DIMENSION OF CONVECTIVE CLOUDINESS OVER THE POLAR OCEAN FROM AVHRR DATA **c47**
Andreas Manschke *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 115-116 (For primary document see N93-21569 07-42)
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The possibility of deriving the vertical dimension of convective cloudfields over oceans by remote sensing with the spaceborne infrared radiometer AVHRR (Advanced Very High Resolution Radiometer) is investigated. A set of atmospheric data for polar cold air outbreaks is prescribed, containing different cloud base and top temperatures, and other parameters influencing the radiative transfer properties. Top of the atmosphere radiances are

then calculated with a one dimensional model of radiative transfer. The optical depth of semitransparent clouds can be estimated from the radiances of the thermal infrared channels of the AVHRR. For such clouds, the base temperature is inferred from top of the atmosphere radiances. For nighttimes, the algorithm yields a root mean square error of 2 K. The cloud top temperature for opaque clouds can be retrieved from channel 5 (approximately 12 micrometers) alone. Assuming a pseudo adiabatic lapse rate within the convective clouds, their vertical extension can be estimated. ESA

N93-21591# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Inst. fuer Physik der Atmosphaere.
DETECTION OF POLAR STRATOSPHERIC CLOUDS FROM SATELLITE **c47**

R. Meerkoetter, R. Buell, and P. Wendling *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 117-121 (For primary document see N93-21569 07-42)

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A bispectral approach for temperature determination of semi transparent clouds is taken to identify areas covered by Polar Stratospheric Clouds (PSC's). The method is based upon the information of two satellite pixels and two spectral channels of the passive HIRS (High Resolution Infrared Sounder) instrument onboard the NOAA satellites. The method succeeds for optically thick PSC's appearing to be inhomogeneous in both satellite pixels, whereas optically thin and homogeneous PSC's are not definitely detectable due to the influence of radiometric noise. Application of the method to NOAA satellite data gained during the major PSC event on 31 Jan. 1989 demonstrates that large areas covered by dense PSC's are clearly found with a horizontal distribution in very good agreement to independent airborne measurements. ESA

N93-21592# Marine Research Inst., Helsinki (Finland).
USE OF ERS-1 SAR DATA IN NUMERICAL SEA ICE MODELING **c48**

Matti Leppaeranta and Zhanhai Zhang (National Research Center for Marine Environment Forecasting, Beijing, China.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 123-128 (For primary document see N93-21569 07-42)

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Numerical models for sea ice thickness distribution and velocity are used for operational forecasting and climatological research. ERS-1 SAR (Synthetic Aperture Radar) is a most promising tool for the modeling work. It gives information to initialize ice models with an improved accuracy and provides ice velocity fields. The velocity is a key element in model development. Preliminary results from using ERS-1 SAR data in ice modeling for the Baltic Sea is presented. The results support that a viscous-plastic ice model gives correct results at least qualitatively. The dominant driving force was the wind while the internal friction of the ice was also of major significance. The value of including these new data is considered and thoughts on possible implications to model development are discussed. ESA

N93-21593# Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Radio and Space Science.
REMOTE SENSING OF ARCTIC SEA ICE USING THE ERS-1 SAR **c48**

J. Askne and L. Ulander *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 129-133 Sponsored by Swedish Board for Space Activities (For primary document see N93-21569 07-42)

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A program for in situ observations of sea ice properties was carried out together with simultaneous ERS-1 coverage along the route of the icebreaker Oden in the Arctic basin. Results from the evaluation are reported including calibration of the SAR (Synthetic Aperture Radar) sensor and ice properties of climatological importance. Algorithms for ice concentration determination are presented with results from the Summer melt period together with backscattering coefficients for various ice types during the advanced melt and early freeze up. The ERS-1 SAR will provide estimates of the ice concentation during the Summer melt with errors estimated to be a few percent and also has the potential to provide many other parameters of climatological interest. ESA

N93-21594# Hamburg Univ. (Germany). Meteorologisches Inst.
DETECTING NEW-ICE IN THE ARCTIC FROM MULTISPECTRAL SATELLITE DATA **c48**

Thomas Martin and Daniel Taurat *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 135-140 (For primary document see N93-21569 07-42)

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An approach to detect new ice is pointed out on the basis of combining different satellite systems. Measurements of the SSM/I (Special Sensor Microwave/Imager) are classified with a threshold scheme. Because of low sensitivity against cloudiness time series could be acquired. More detailed phenomena are detected on the basis of AVHRR (Advanced Very High Resolution Radiometer) data. The new ice coverage is retrieved with synthetic brightness temperatures. Both satellite systems are compared in a case study. The results of the satellite based new ice classification are supported by ship observations. ESA

N93-21595# Mullard Space Science Lab., Dorking (England).
SATELLITE MONITORING OF GIANT TABULAR ICEBERGS Abstract Only **c48**

S. Laxon, C. G. Rapley, and G. Davies *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 141 (For primary document see N93-21569 07-42)

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A summary of a study reporting the monitoring of several giant tabular icebergs that have recently broken off the southern ice shelves is presented. Geosat radar altimetry is used to produce a contour map of the ice shelf before and after the calving of two icebergs from the Larsen ice shelf in 1986 and to measure their changing thickness as they travel up through the Weddel Sea. Passive microwave data from the DMSP satellite is used to map the position of the icebergs showing motion in sympathy with ocenaographic currents and eddies. Data from the newly launched ERS-1 satellite, which carries a radar altimeter and an infrared imaging instrument (ATSR), is also presented. ERS-1 allows monitoring of three large icebergs which calved from the Filchner ice shelf which were too far south to be monitored by Geosat. ESA

N93-21596# Mullard Space Science Lab., Dorking (England).
SATELLITE RADAR ALTIMETRY OVER SEA ICE Abstract Only **c48**

S. Laxon *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 143 (For primary document see N93-21569 07-42)

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A summary from a study presenting results from past altimeter missions, showing how the data can be used to validate and supplement observations by other sensors, is given. Comparisons of ice extent mapped by radar altimetry with that mapped using passive microwave sensors showed significant differences in the ice boundary position. Results from the newly launched ERS-1 satellite, which provides radar altimeter coverage of the entire Southern Ocean and the high Arctic for the first time, were also presented. ESA

N93-21597# Bremen Univ. (Germany). Inst. of Remote Sensing.
IMPROVED USE OF PASSIVE MICROWAVE DATA FOR SEA ICE DETECTION **c48**

G. C. Heygster, B. A. Burns, T. Markus, L. Meyer-Lerbs, R. Sethmann, and R. P. Tietze *In* ESA, Environment Observation and Climate Modelling

Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 145-150 (For primary document see N93-21569 07-42)
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A study on signal and image processing applications to improve the sea ice detection with passive microwave imagery is reported. Three deconvolution techniques, a Wiener filter, and two entropy based algorithms were used to improve the horizontal resolution. A blind deconvolution algorithm determining two images given only their noisy convolution checks the antenna pattern or possible changes after launch. Sea ice concentrations derived from passive microwave imagery using different algorithms and from AVHRR (Advanced Very High Resolution Radiometer) images are projected into a common grid and compared. The results of a method for detecting subpixel scale polynya based models for the brightness temperature transition from sea ice to Antarctic shelf ice with and without polynya are compared to AVHRR data and wind data. Software utilities allow for the visual inspection of very large image data sets such as on the SSM/I (Special Sensor Microwave/Imager) polar regions CD-ROM's (Compact Disc-Read Only Memories) by converting them into a video film. ESA

N93-21598# Centre National de Recherches Meteorologiques, Toulouse (France).
A 2 X CO2 EXPERIMENT WITH PRESCRIBED CHANGES IN SEA SURFACE TEMPERATURE **c48**
J.-F. Mahfouf, J.-F. Royer, and D. Cariolle *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 151-155 Sponsored by Programme National d'Etude de la Dynamique du Climat (For primary document see N93-21569 07-42)
(Contract EPOCH-0003-C-MB)
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The climate response to an increase in carbon dioxide is examined with a climate model. This model has a high vertical resolution in the stratosphere and predicts the evolution of the zone mixing ratio. This quantity is fully interactive with radiation and photochemical production and loss rates are accounted for. Sea surface temperature anomalies are prescribed at the lower boundary from the results of a 100 year transient simulation with a global ocean-atmosphere model. Results from an annual cycle indicate a global warming of 1.5 K and an increase in precipitation rate of 2.8 percent. The model simulates a strong stratospheric cooling of up to 10 K leading to a column ozone enhancement of about 5 percent. Other features present in similar studies are also exhibited (stronger surface warming in polar regions of the Northern Hemisphere; summertime soil moisture drying in mid latitudes; and increase in high convective cloudiness in tropical regions). ESA

N93-21599# Deutscher Wetterdienst, Offenbach am Main (Germany).
COMPARISON OF MONTHLY PRECIPITATION ANALYSES DERIVED FROM CONVENTIONAL MEASUREMENTS, SATELLITE ESTIMATES AND MODEL RESULTS **c47**
B. Rudolf, H. Hauschild, M. Reiss, and U. Schneider *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 157-162 (For primary document see N93-21569 07-42)
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The purpose of the Global Precipitation Climatology Centre (GPCC) is to evaluate and disseminate global data sets of monthly precipitation totals on a grid of 2.5 deg for a period of ten years, 1986-1995. The results will provide a data base for investigating climatic changes, determination of Earth water balance and fluxes, and especially for verification and initialization of atmospheric circulation and climate models. Gage measured data are the main basis for analyzing the monthly precipitation totals over land. Satellite data are used to estimate the precipitation over oceanic regions, but for a complete global analysis some complete fields such as results for numerical weather prediction models are needed. The scientific task of the GPCC is to develop objective methods for data correction, computation of areal mean precipitation totals on the grid, filling data gaps, and merging the data from different sources. Global manual isothermal analyses will be carried out for reference months to verify the results of the objective methods. The GPCC started operations by the end of 1988. The planned routine procedures are described and the current state of work is presented. A comparison between the results from data sources is carried out separately for land and ocean areas. ESA

N93-21600*# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
MICROWAVE RADIOMETRY FOR MONITORING THE DIVERSE CLOUDINESS REGIMES ON EARTH: A REVIEW **c47**
Kristina B. Katsaros *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 163-168 (For primary document see N93-21569 07-42)
(Grants NAGw-1688; NAG5-943)
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Recent work concerning the use of microwave radiometers in space to provide views of the water content of clouds is reported. Recently, theoretical algorithms were refined and the sampling by microwave radiometers for polar orbiting satellite became more commensurate in resolution and coverage with the scale of the meteorological phenomena. Parameters available from the Special Sensor Microwave/Imager (SSM/I) include total integrated water vapor (kg/sq m), integrated cloud liquid water (kg/sq m), rain rate (mm/hr), and an index for the presence and concentration of large ice particles; this so called scattering index can also be converted to a rain rate, although conversion is still rather uncertain. The hydrologic aspects of climatically important cloud systems on the Earth such as subtropical stratus decks, tropical convection, and midlatitude and polar cyclone can thus be monitored with the SSM/I parameters. The diagnostic as well as prognostic potential of these satellite derived water content properties of cloud systems are also discussed. ESA

N93-21601# Laboratoire de Meteorologie Dynamique, Paris (France).
CLIMATOLOGICAL USE OF LONG TIME SERIES OF DATA FROM THE WATER VAPOUR CHANNEL OF METEOSAT **c47**
Michel Desbois, Laurence Picon, and Simeon Fongang (Dakar Univ., Senegal.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 169-172 (For primary document see N93-21569 07-42)
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The processing of six years of water vapor Meteosat 2 data (May 1983 - Jul. 1988) for the establishment of reliable statistics is reported. The first results are presented in the form of 10 days and monthly averages of 5.7 to 7.1 micrometers equivalent radiative temperatures. These results are intended to be used to study the relationship between the convective activity and the middle and upper tropospheric water vapor which would have an important efffect on the problem of greenhouse effects feedback. An analysis of the seasonal and internannual variations of the tropical circulations is also undertaken. This long time series is to be used for the validation of long runs of climate models. ESA

N93-21602# Mullard Space Science Lab., Dorking (England).
LAKE REMOTE SENSING FOR GLOBAL CLIMATE RESEARCH **c45**
A. R. Harris, I. M. Mason, C. M. Birkett, and J. A. D. Mansley *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 173-178 (For primary document see N93-21569 07-42)
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The importance of remote sensing of lake area and level changes for cimate research, particularly for closed lakes in semi arid regions is noted, and the initial need for simultaneous measurement of level and area is discussed. ERS-1 is uniquely suited to the latter task, carrying a radar altimeter and the ATSR (Along Track Scanning Radiometer), the latter providing regular global repeat coverage at 1 km resolution for the first

time. A global database of the world's large lakes (greater than or equal to 100 sq km in areas) was created and the altimeter coverage for the various repeat orbit phases was assessed. The accuracy of a precise area measurement algorithm is assessed using simulated coarse resolution data for a semi arid closed lake. Results using data from the AVHRR (Advanced Very High Resolution Radiometer) instrument (similar to ATSR) showing the area cycle of a small (approximately 140 sq m) climatically sensitive lake over a five year period are presented, which demonstrates a strong correlation with climate. ESA

N93-21603# Hamburg Univ. (Germany). Meteorologisches Inst.
REMOTE SENSING OF LATENT HEAT FLUXES AT THE AIR-SEA INTERFACE **c43**
Joerg Schulz and Peter Schluessel *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 179-183 (For primary document see N93-21569 07-42)
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A method to determine latent heat fluxes using spaceborne sensors is presented. Sea surface temperature is retrieved from the Advanced Very High Resolution Radiometer (AVHRR) with an accuracy of 0.5 to 1.0 K. Near surface wind speed and the amount of water vapor w(sub l) in the lowermost 500 m of the atmosphere are retrieved from measurements of the Special Sensor Microwave/Imager (SSM/I) with accuracies of 1.4 m/s and 0.06 g/sq cm respectively. A linear relationship is used to determine the near surface specific air humidity from w(sub l) with an accuracy of 1.2 g/kg. The combination of all methods leads to an overall estimated error of 30 to 40 W/sq m for the parameterized latent heat flux. ESA

N93-21604# Ecole Nationale Superieure des Mines, Sophia-Antipolis (France). Centre d'Energetique.
AIR/SEA LATENT HEAT FLUX MEASUREMENTS WITH MICROWAVE RADIOMETERS **c43**
F. Cauneau and R. Bernard (Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux, France.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 185-188 Sponsored by Centre National d'Etudes des Telecommunications, CNRS, and Inst. National des Sciences de l'Univers (For primary document see N93-21569 07-42)
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The Scanning Microwave Multichannel Radiometer (SMMR) onboard Seasat A during Summer 1978 gave measurements of atmospheric and sea surface parameters, from which estimations of the ocean-atmosphere latent heat flux can be achieved using the Liu model. Comparisons between the zonal monthly mean profiles of the latent heat flux computed by the model and those of each of its calculus components provided by the SMMR show a strong dependency of evaporation upon the vertical humidity gradient, except in the tropical zone. Detailed examination reveals a strong hemispheric asymmetry, large evaporation fluxes occur in the Southern Hemisphere in winter. The mapping of the latent heat flux on global scales enhanced the regional contrast. It shows the similarity between the SMMR observations and the main oceanic flux structures, despite the observational errors and modelization hypotheses. Spatial structure of the latent heat flux field is then analyzed by means of the autocorrelation function. Comparison with similar computations applied to its calculus components shows specific properties of the latent heat flux field, especially strong spatial anisotropy, and low zonal decorrelation. A bidimensional autocorrelation model, based on the assumption of a first order autoregressive process, is deduced from the observations. ESA

N93-21605# United Nations Educational, Scientific and Cultural Organization, Paris (France). Water Sciences Div.
MONTHLY PRECIPITATION AND RUNOFF DATA FOR VALIDATION OF CLIMATE MODELS **c47**
A. Aureli, A. Becker (Freie Univ., Berlin, Germany.), S. Kaden (WASY Ltd., Berlin, Germany.), and S. I. Solomon *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 189-195 (For primary document see N93-21569 07-42)
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A study addressing the best practical means of interfacing general circulation models with hydrological models is presented. Climate models require for their validation estimates of precipitation and runoff assessed for intervals of one month or less, on a grid basis compatible with that used by these models. Precipitation measurements on the ground are obtained over very small areas generally located far apart and in most cases in sites that are not representative of the general geophysical characteristics of the area and/or the pertinent model grid. Flow measurements provide information on river basin areas that obviously are not compatible with the above mentioned grid. Flow data, particularly those obtained on large rivers, do not reflect runoff conditions at the time of measurement. A technique in which terrain models, satellite and meteorological radar data, and precipitation and river flow measurements combined through meteorological and hydrological models, provide estimates that are compatible with the climate models grid and sufficiently accurate to be of use in the validation of such models, is proposed. ESA

N93-21606# Mullard Space Science Lab., Dorking (England).
ERS-1 RADAR ALTIMETRY OF ICE SHEETS Abstract Only **c43**
C. G. Rapley, J. Morley, and S. Laxon *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 197 (For primary document see N93-21569 07-42)
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A summary of a report presenting preliminary results from the ERS-1 altimeter is presented. An evaluation of its performance and the first height maps to 82 deg south was included. A limitation on the data to date was the +/- 72 deg latitude coverage achieved. ERS-1 represents a significant advance over past missions by providing coverage to +/- 83 deg latitude, permitting for the first time mapping of all of the Greenland ice sheet and the major part of Antarctica including the major Ross and Ronne-Filchner ice shelves and the potentially climatically sensitive west Antarctica. The altimeter is also provided with an ice tracking mode which is designed to permit operation of terrain with greater relief than has previously been possible, although with reduced precision. ESA

N93-21607# Italian Space Agency, Rome.
REQUIREMENTS AND PROJECTS FOR HIGH-RESOLUTION ATMOSPHERIC SOUNDING **c47**
Bizzarro Bizzarri *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 201-210 (For primary document see N93-21569 07-42)
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The requirements for satellite sounding of temperature and humidity profiles are reviewed, and the evolution of satellite instrumentation since 1969 is described. An assessment of satellite sounding impact shows that, even when better assimilation schemes and the near term instrument developments are implemented, the present generation of sounding radiometers will not fulfill the requirements of the year 2000. The case for improved spectral resolution, its impact on vertical resolution, and the basic comparison between different approaches (interferometer and grating spectrometers) are discussed. The IASI (Infrared Atmospheric Sounding Interferometer) project is outlined, showing the contribution of high spectral resolution sounders to applications outside meteorology. ESA

N93-21608# Swedish Meteorological and Hydrological Inst., Norkoeping.
USE OF AVHRR-DERIVED CLOUDINESS AND PRECIPITATION IN OPERATIONAL WEATHER FORECASTING AND IN MODEL STUDIES **c47**
Karl-Goeran Karlsson *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 211-216 (For primary document see N93-21569

07-42)
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A multispectral cloud classification algorithm is reported. It is a thresholding technique using six features derived from the original Advanced Very High Resolution Radiometer (AVHRR) dataset together with geographical map information and objective temperature analyses. Comparisons with summertime hourly cloud observations at synoptical weather stations have shown root mean square errors in the range of 2 and 3 octas and mean errors near -1 octa for the total fractional cloud cover. Best agreement was found for high sun elevations and high satellite elevations. Problems were encountered at sunrise and at sunset, especially in winter and in situations with low satellite elevations for cases with anisotropic reflection. Work is now focused on developing methods to utilize the derived cloud information in objective analysis schemes. ESA

N93-21609# European Centre for Medium-Range Weather Forecasts, Reading (England).
THE WAM MODEL AND ERS-1 **c43**
H. Guenther (GKSS-Forschungszentrum Geesthacht, Germany.) and B. Hansen *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 217-221 (For primary document see N93-21569 07-42)
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A study aimed at supporting the calibration and validation of the ERS-1 radar altimeter is presented. The third generation WAM wave model was used in connection with a wave data assimilation system to study the radar altimeter during the calibration/validation phase of ERS-1. The data quality control system in particular was applied to check the wind and wave measurements and provide input to ESA in real time. Extensive comparisons of model computations with ground truth and satellite data were done. Very good agreement between model and buoy wave heights and wind speeds was found. The calibrated ERS-1 radar altimeter wave and wind data compare very well with the model analysis on a global scale, but evidence was detected that the altimeter underestimates high sea states. Presently, the full wave data assimilation system is used to study the impact of the altimeter on wave analysis and forecasts. ESA

N93-21610# European Centre for Medium-Range Weather Forecasts, Reading (England).
HOW REAL-TIME DATA ASSIMILATION BENEFITS WEATHER AND CLIMATE STUDIES THROUGH THE VALIDATION, QUALITY CONTROL AND SYNTHESIS OF REMOTELY SENSED DATA **c47**
A. Hollingsworth *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 223-224 (For primary document see N93-21569 07-42)
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Challenges in NWP (Numerical Weather Prediction) are discussed. Real time data assimilation of satellite data at NWP institutes facilitates a systematic three way dialogue between the satellite agencies, the data assimilators, and the weather and climate models. The dialogue has motivated scientific advances in interpretation of satellite data, in assimilation methods, and in modeling for weather and climate studies. Along the way, the NWP institutes have contributed to calibration/validation and to long loop monitoring of satellite data, as well as providing the climate community with rapid and complete syntheses of all available data. For this constructive dialogue to flourish it is necessary that the NWP institutes be given real time access to satellite data of meteorological or oceanographic relevance. Such access is not planned for a number of future satellite missions. It is most desirable that the mission planners reconsider the issue of real time data delivery. ESA

N93-21611# Royal Netherlands Meteorological Inst., De Bilt.
ROUTINE VALIDATION OF TOVS RETRIEVALS: LESSONS LEARNED FROM A PILOT EXPERIMENT **c47**
G. J. Prangsma *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 225-228 (For primary document see N93-21569 07-42)
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The basic ideas behind the TOVS (Tiros Operational Vertical Sounder) satellite data and retrieved profiles (atmospheric temperature and humidity) validation schemes are presented with preliminary results from a pilot experiment. Such validation is required prior to data assimilation for numerical weather prediction and global climate analysis. From the intercomparison, TOVS retrieval is considered to perform just as well as radiosondes, considering the results for standard atmospheric layer thicknesses. However, large differences occur in synoptic situations where strong vertical temperature gradients are an important factor. Some of the weak points in the TOVS scheme are illustrated. Future research will be focused on developing an a priori detection mechanism for the synoptic context of the TOVS radiance observations. ESA

N93-21612# Centre de Meteorologie Spatiale, Lannion (France).
TRANSMITTANCE COEFFICIENTS GENERATION FOR FAST RADIATIVE TRANSFER MODELS: APPLICATION TO NEW SATELLITE SOUNDING SYSTEMS **c43**
P. Brunel, L. Lavanant, and G. Rochard *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 229-233 (For primary document see N93-21569 07-42)
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Polynomial transmittance coefficients internal to the RTTOV fast radiative transfer model were generated, with atmospheric transmittances calculated by using the FASCOD2 line by line model. The FASCOD2 computations are made for a small set of Earth representative profiles, uniformly mixed gases and water vapor molecular species separately and different scanning angles and pressure levels. The accuracy of the process is checked for the NOAA11 TOVS channels. A transmittance storage at a medium frequency is tested. This storage allows afterwards any filter convolution of the transmittances and a quick adaptation of the RTTOV model for any new channels. ESA

N93-21613# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). HA Systemanalyse Raumfahrt.
RETRIEVAL OF CLOUD LIQUID WATER AND PRECIPITATION FROM POLARIZED MICROWAVE SIMULATIONS AND SSM/I MEASUREMENTS **c47**
Peter Bauer (Hamburg Univ., Germany.) and Peter Schluessel *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 235-240 (For primary document see N93-21569 07-42)
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A radiative transfer model was developed for the simulation of millimeter wavelength radiances emerging from cloudy and precipitating atmospheres over oceans. The model fully solves for multiple scattering as well as for polarization effects at hydrometetors and at the surface including variable structures and microphysics of the clouds and their spatial inhomogeneity within the radiometer's field of view. A set of 340 atmospheric profiles from global radiosonde ascents is entered into the model in order to simulate the dual polarized radiometer signals as measured in the spectral channels of the Special Sensor Microwave/Imager (SSM/I). A multivariate analysis is carried out to derive retrieval algorithms for the measurement of cloud and rain, liquid and ice water paths as well as surface rain rates from satellite observations. Estimated standard errors show values of less than 10 percent of the deduced parameters. The new retrieval techniques are applied to SSM/I passive microwave soundings from Aug. 1987 to derive global maps of precipitation and cloud water contents. Observations from other satellites are compared to the retrievals of surface rain rates. ESA

N93-21614# Bulgarian Academy of Sciences, Sofia. Electronics Inst.
COMPARISON OF THE EFFICIENCIES OF LIDAR TECHNIQUES FOR ATMOSPHERIC-TEMPERATURE MEASUREMENT BASED ON ROTATIONAL RAMAN, AND RAYLEIGH SCATTERING **c47**

I. D. Ivanova, L. L. Gurdev, and V. M. Mitev *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 241-244 (For primary document see N93-21569 07-42)

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RRS (Rotational Raman Scattering) methods for atmospheric temperature measurements are described and compared: RS (Rayleigh Scattering) and RBS (Rayleigh-Brillouin Scattering). In principle, the considered RS (RBS) methods are more efficient than the RRS ones because they have considerably higher potential accuracy, giving considerably shorter measuring time intervals to reach required accuracy. Both RS methods always have comparable efficiencies. They are also noise protected to a higher extent in comparison with the two RRS methods. The final choice of a lidar method for measuring atmospheric temperature profiles might depend on the various additional factors. ESA

N93-21615# Bulgarian Academy of Sciences, Sofia. Solar-Terrestrial Influence Lab.

MODEL PROFILES OF ATMOSPHERIC TEMPERATURES, PRESSURES AND DENSITIES IN SOUTH-EASTERN EUROPE DURING MAXIMUM AND MIMIMUM SOLAR ACTIVITY **c47**

P. I. Vellinov, Khristo V. Spassov, and Liubka P. Milenkova *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 245-250 (For primary document see N93-21569 07-42)

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A model for the profiles of the temperature T(h), pressures P(h) and densities D(h), in the height interval h = 20 to 80 km is represented on the basis of rocket measurements which took place in Akhtopol, Bulgaria: 42 06 north, 27 51 east. The experiments were realized with the aid of the Russian rockets M-100 B in the period 1982-1990. T(h), P(h) and D(h) profile in periods with different solar activity phases, as well as average profiles for the whole period, are represented. Comparisons are made with the COSPAR International Reference Atmosphere 1972 and 1986 (CIRA 1972 and CIRA 1986). Significant differences, especially in the Winter, are found between the results and the CIRA model. During the Summer period the comparison gives more satisfactory coincidence with CIRA data. Results are discussed as a basis for further improvement of the reference atmosphere CIRA. ESA

N93-21616# Hamburg Univ. (Germany). Inst. fuer Meereskunde.

VALIDATION OF ERS-1 SYNTHETIC APERTURE RADAR FOR IMAGING OCEAN WAVES: FIRST RESULTS **c48**

Claus Bruening, Werner Alpers, Andreas Wilde (GKSS-Forschungszentrum Geesthacht, Germany.), and Friedwart Ziemer *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 251-255 (For primary document see N93-21569 07-42)

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Synthetic Aperture Radar (SAR) images of the European ERS-1 satellite were obtained over the Norwegian Sea during the ERS-1 Haltenbanken Calibration/Validation Campaign in Nov. 1991. SAR image spectra calculated from the full swath SAR images are compared with Monte Carlo method simulated SAR image spectra computed from ocean wave height spectra measured by a directional waverider buoy. The SAR imaging of ocean waves is described by the velocity bunching model. It predicts strong nonlinear mapping distortions for wave components propagating in flight (azimuth) direction. This is seen in all SAR images analyzed. Even one example is shown where azimuthally traveling waves with a mean wavelength of 128 m are completely smeared out and not imaged at all by the ERS-1 SAR. On the other hand, range traveling waves can be imaged by ERS-1 SAR down to wavelengths of 64 m as evidenced by an image obtained over the Mediterranean Sea. ESA

N93-21617# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Optoelectronics Inst.

REPRESENTATIVITY OF WIND MEASUREMENT FROM SPACE **c47**

C. Werner, J. Streicher, and G. Wildgruber (Sensorlab G.m.b.H., Munich, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 257-260 (For primary document see N93-21569 07-42)

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The aim of this study for ESA's Atmospheric Laser Doppler Instrument ALADIN was to carry out a preliminary assessment of the representativity with which wind data could be derived from a conically scanning spaceborne wind lidar. For this purpose it used Doppler wind data recorded by canonically scanning, surface based Doppler lidars. This lidar measures the three dimensional wind field using the same technique. Contrary to the spaceborne application it determines the wind using many line of sight wind components. This determined wind level is furthermore the true wind. The main question to be answered was: how representative is a single line of sight component? The basis for this study was data material from the NOAA ground based Doppler lidar. The results are: the representativity of a single line of sight component depends mainly on the laser stability; the accuracy depends also on the atmospheric aerosol loading; one single Doppler lidar measurement is representative of the wind field to within +/- 1 m/s for 30 of all measurements (if there is enough aerosol); by averaging over 4 single range rates this value increases to 50; short averaging does not improve the representativity very much. ESA

N93-21618# Technische Univ., Munich (Germany). Meteorologisches Inst.

SAMPLING PROPERTIES OF A SPACEBORNE LIDAR (ATLID) **c43**

Joerg Ackermann, Matthias Wiegner, and Heinrich Quenzel *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 261-265 (For primary document see N93-21569 07-42)

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ATLID (Atmospheric Lidar) is a backscatter lidar planned to be flown on a polar platform at the beginning of the next century. The potential of a backscatter lidar is the determination of cloud top height and, in case of cloudfree conditions, the height of the planetary boundary layer with a very high accuracy. The measured height z, colocated with a brightness temperature T from an imager, will provide a T(z) relationship, which improves existing TOVS (Tiros Operational Vertical Sounder) retrieval schemes by about 1K. These retrievals have a horizontal resolution of about 100 by 100 km, whereas the footprint of a lidar shot is about 800 m. The resulting sampling problem is assessed by calculating the pixel spacing of different ATLID scan modes. Several statistical tests are performed to select that scan mode, which gives the best reproduction of a cloud field for different meteorological situations. It turns out that ATLID should have a sinusoidal scan mode with a pulse repetition rate of about 100 Hz and a scan period of 3.2 s. A global cloud climatology has shown that in about 66 percent of all atmospheric conditions ATLID will provide useful information in order to improve TOVS retrieval. ESA

N93-21619# Bulgarian Academy of Sciences, Sofia. Geophysics Inst.

EMPIRICAL MODEL OF WINDS IN SOUTH-EASTERN EUROPE IN CONNECTION WITH SOLAR ACTIVITY **c47**

Khristo V. Spassov, P. I. Vellinov, and Liubka P. Milenkova *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 267-271 (For primary document see N93-21569 07-42)

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Profiles on the wind velocities V(h) in the height interval H = 20 to 60 km (measured by Russian rockets M-100 B) in Akhtopol (42 06 north, 27 51 east), Bulgaria, are represented. The zonal Vx and meridional Vy wind components are shown. The data obtained refer to the 1982-1990 period for both Summer and Winter; they include years with different solar activity W (W is the sunspot number). This allows the dependencies of Vx(h) and

Vy(h) on the solar activity level to be obtained: maximum and minimum solar activity. Such dependencies are not given in COSPAR International Reference Ionosphere CIRA 1972 and CIRA 1986. A comparison between the data and CIRA model is made. Recommendations for Reference Atmosphere are given. These improvements refer mainly to the Winter period. ESA

N93-21620# Ecole Nationale Superieure des Mines, Sophia-Antipolis (France). Centre d'Energetique.

ASSIMILATION OF SATELLITE BORNE WIND SCATTEROMETER OBSERVATIONS **c47**

F. vandenBerghe and F. Cauneau *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 273-278 (For primary document see N93-21569 07-42)

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A variation formulation involving the adjoint technique is used to directly assimilate Seasat A Scatterometer Satellite (SASS) surface wind measurements into a numerical model of the relative vorticity evolution. The discretized vorticity equation underlying the model simulates the global circulation in a rectangular bassin in a beta plan approximation and satellite wind borne scatterometer observations are assimilated in order to produce sea surface wind fields. The variation formalism is described, and the adjoint equation is introduced. The variational assimilation procedure is then compared to Kalman filtering on real wind speed data issued of the successive passages of the Seasat satellite over the north Atlantic between 11 Sep. 1978, 00 GMT and 12 GMT. This allows tracking of the evolution of the famous QE 2 severe storm in the global circulation of the north Atlantic ocean. ESA

N93-21621# Deutscher Wetterdienst, Offenbach am Main (Germany).

UTILIZATION OF REMOTE SENSING DATA AT THE DEUTSCHER WETTERDIENST **c47**

W. Benesch *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 279-282 (For primary document see N93-21569 07-42)

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The use of satellite images for more than 25 years for weather monitoring and very short range forecasts is reported. Quantitative parameters derived from satellite data at specific centers are used in operational numerical weather prediction. Cooperation activities are performed with research institutes in order to improve the quality of derived parameters, to assign quality flags to each parameter and to adopt new processing methods. Satellite data will be used in agrometeorological and climatological studies, and have become an indispensable tool for the legal tasks of the meteorological service. Hence a Meteosat second generation is needed with improved performances and meteorological data from polar orbiting satellites are required from the morning and the afternoon orbit. ESA

N93-21622# Centre de Meteorologie Spatiale, Lannion (France).

OPERATIONAL CLOUD CLASSIFICATION WITH METEOSAT DATA **c47**

B. Bellec, A. Brisson, P. LeBorgne, and A. Marsouin *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 283-288 (For primary document see N93-21569 07-42)

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An operational cloud classification method based on the use of the cluster technique earlier established by Desbois and Seze was developed for application to Meteosat data. A first experiment on a test data set representative of various seasons over France allowed the principles of an operational application of the method to be defined. The operational scheme was applied on an experimental basis, over France, in Mar. and Apr. 1991. The results of the automatic cloud classification were validated by experienced nephanalysts. They are overall satisfactory, however low or medium clouds are not as well defined as surface, cirriform and high thick clouds. The main problem is a possible confusion at night between surface and low stratiform clouds. ESA

N93-21623# Technische Univ., Vienna (Austria). Inst. of Meteorology.

QUALITATIVE AND QUANTITATIVE DIAGNOSIS OF CLOUD IMAGES FOR USE IN WEATHER FORECAST **c47**

V. Zwatz-Meise and J. Stockinger *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 289-295 (For primary document see N93-21569 07-42)

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Ideas on the integration of satellite images, an important tool for an operational weather service, into the analysis seen from a weather service, are discussed. The diagnosis of cloud configurations with the help of relevant meteorological parameters and the quantitative evaluation of gray shades in respect to precipitation informations are described. Examples for both ways of analysis are shown. ESA

N93-21624# Hungarian Meteorological Society, Budapest. Satellite Research Lab.

BISPECTRAL CLOUD ANALYSIS FOR THE ATLANTIC-EUROPEAN REGION USING DIGITAL METEOSAT IMAGES **c47**

E. Fejes and J. Kerenyi *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 297-300 (For primary document see N93-21569 07-42)

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An objective analysis based on bispectral cloud analysis which was applied to the satellite cloudiness field is presented. The bispectral models separate the different types of cloudiness from the brightness values of the visible and the infrared images using threshold values. The standard deviation was also taken into account, allowing the selection of the structure of status and cumulus clouds. Because of the dependence of the threshold values, on solar elevation and seasonal change, these parameters were also incorporated into the model as a further development. The model can be applied not only to the original satellite images but the pictures can be transformed to different projection. The evaluation was made by examining several different weather situations. ESA

N93-21625# Hungarian Meteorological Society, Budapest. Satellite Research Lab.

DETERMINATION OF LONGWAVE RADIATION REACHING THE SURFACE FROM METEOSAT IMAGES AND RADIATION MODEL CALCULATIONS **c43**

A. Rimoczi-Paal *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 301-304 (For primary document see N93-21569 07-42)

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A study aimed at developing a method for estimating the longwave radiation using satellite images is presented. The downward longwave radiation at the surface is one of the most important components of the radiation balance because the changes of the longwave radiation reaching the surface significantly affect the surface temperature. The direct observations of the downward longwave radiation at the surface occur only in a few dozen meteorological stations thus application of the satellite measurements gives a new possibility in the mapping of this component of the radiation balance. In the method, the radiative fluxes are calculated with a radiative transfer model. The input parameters are radiosonde and satellite measurements. Applying this method the radiation maps are more detailed than the one constructed only from surface measurements. ESA

N93-21626# Saga Univ. (Japan). Dept. of Information Science.

A COMPARATIVE STUDY OF ESTIMATION OF PARTIAL CLOUD COVERAGE WITHIN A PIXEL: PROPOSED ADAPTIVE LEAST SQUARE METHOD WITH CONSTRAINTS **c47**

K. Arai, Y. Ueda, and Y. Terayama *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 305-310 Sponsored by National Space Development Agency, Japan (For primary document see N93-21569 07-42)

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A comparative study on estimation of partial cloud cover within a pixel, in order to use the pixels partially contaminated with cloud on a sea surface temperature estimation, is presented. From the experimental results with the simulation data generated with observation noise, a relationship was found among an observation noise, mixing ratio and estimation accuracy in the case where the variance of cloud was greater than that of the ocean. In such a case, estimation accuracy decreases in accordance with the increasing of cloud cover and observation noise. An adaptive least square method is proposed which shows a good estimation accuracy compared to the other methods. In particular when the number of classes designated for proportion estimation (in this case two classes, cloud and the ocean) is greater than the number of channels, or dimensionality of the observation vector, the proposed method is superior to the other methods based on the best linear estimation and other least square methods. ESA

N93-21627# Hamburg Univ. (Germany). Meteorologisches Inst.

MEASUREMENT AND INTERPRETATION OF THE SUNLIGHT BACKSCATTERED FROM CLOUDS WITHIN THE OXYGEN-A ABSORPTION BAND **c47**

M. Kollewe, W. Cordes (GKSS-Forschungszentrum Geesthacht, Germany.), and J. Fischer (Technische Univ., Berlin, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 311-315 (For primary document see N93-21569 07-42)

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Airborne lidar measurements carried out to obtain information about processes affecting the O2-A band are reported. Measurements of the upwelling radiance within the A absorption band of oxygen in the spectral range from 750 to 782 nm were performed with a spectral resolution of 0.42 nm. A principal component analysis of the recorded spectra results in three independent parameters. Model calculations of the radiative transfer in a cloudy atmosphere to simulate the measured spectra are in process. The matrix operator method is used. First analyses show the same features of both the measured and modeled spectra and result in three principal components as well. ESA

N93-21628# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany).

CLEOPATRA: A STEP TOWARDS GEWEX ON THE REGIONAL SCALE **c47**

P. Meischner, T. Hauf, W. Jaeschke (Johann-Wolfgang-Goethe-Univ., Frankfurt am Main, Germany.), T. Kriebel, W. Mauser (Technische Univ., Munich, Germany.), J. Nithack, H. Pruppacher (Mainz Univ., Germany.), A. Schroth, and U. Schumann *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 317-322 (For primary document see N93-21569 07-42)

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The field program CLEOPATRA, cloud and cloud transports experiment, scheduled 11 May - 31 Jul. 1992 in Oberpfaffenhofen (Germany, F.R.), is described. The scientific goals, partly contributing to GEWEX (Global Energy and Water Cycle Experiment), the overall strategy combining ground based measurements with coordinated aircraft missions, and satellite observations are described. The observation systems, ground based and airborne, are summarized. ESA

N93-21629# Centre de Meteorologie Spatiale, Lannion (France).

SST MONITORING OF THE EUROPEAN SEAS WITH AVHRR DATA **c48**

M. Derrien, O. Gaillard, P. LeBorgne, C. LeGoas, and A. Marsouin *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 323-327 (For primary document see N93-21569 07-42)

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An analysis of fine scale AVHRR (Advanced Very High Resolution Radiometer) derived Sea Surface Temperature (SST) fields (space resolution: 2 km) made daily at CMS (French center of space meteorology) to provide the French navy, oceanographers and some fishing activities, with real time or climatological information concerning the sea surface temperatures over the European seas, is discussed. A split window technique including a satellite zenith angle correction term is at present in use at CMS, and the accuracy of the satellite estimates is checked regularly by comparison with in situ measurements. A processing suite based on the use of an interactive image processing system was built. Various studies or products are based on this suite, ranging from daily, weekly (etc.) charts to the making of an SST atlas over Europe. Basic problems raised by SST retrieval and solutions adopted are reviewed and the use of the interactive system and the products resulting are described. ESA

N93-21630# Southampton Univ. (England). Dept. of Oceanography.

MAPPING OF SATELLITE-DERIVED SEA SURFACE TEMPERATURES AT HIGH RESOLUTION IN CLOUDY REGIONS **c48**

Ian S. Robinson and Paul Smith *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 329-334 (For primary document see N93-21569 07-42)

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The difficulties and errors associated with mapping the Sea Surface Temperature (SST) at high spatial resolution, from satellite infrared scanning radiometers are examined in relation to sea areas which are regularly cloudy, with particular emphasis on the North Sea. Errors in the absolute calibration and atmospheric correction of infrared images cause problems in constructing a composite map. The criteria for selecting the temporal and spatial sampling characteristics of the composite image are examined in the context of the natural variability of the SST, the characteristic cloud patch statistics and the inherent accuracy of SST recovery. The criteria are illustrated by application to a year's North Sea AVHRR (Advanced Very High Resolution Radiometer) data for 1989. If more than one overpass is used to generate a map the spatial resolution must be degraded if artifacts of the compositing process are not to dominate the result. ESA

N93-21631# Joint Research Centre of the European Communities, Ispra (Italy). Safety Technology Inst.

MODELLING THE SKIN-BULK TEMPERATURE DIFFERENCE NEAR THE SEA-ATMOSPHERE INTERFACE FOR REMOTE SENSING APPLICATIONS **c43**

W. Eifler *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 335-340 (For primary document see N93-21569 07-42)

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From the turbulence characteristics of the double atmospheric oceanic boundary layer an analytic model is derived which describes the skin bulk temperature difference as a function of the skin friction and skin heat fluxes. The only free parameter of the model is the (average) length of the momentum, heat and mass transfer governing wave (spectrum). Here the assumption is assessed, that the young waves with a length of a few cm are the relevant transfer waves. Using independently from the wind speed a constant wave length of 3 plus or minus 1 cm, satisfactory agreement is obtained with sea truth observations. ESA

N93-21632*# Hamburg Univ. (Germany). Meteorologisches Inst.

A COMPREHENSIVE COMPARISON BETWEEN SKIN AND MULTI-CHANNEL SEA SURFACE TEMPERATURES AS DERIVED FROM AVHRR **c43**

Peter Schluessel, Gary A. Wick (Colorado Univ., Boulder.), and William J.

Emery (Colorado Univ., Boulder.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 341-346 Sponsored by NASA and DFG (For primary document see N93-21569 07-42)

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Global maps of Satellite Measured Surface Skin Temperature (SMSST), MultiChannel Sea Surface Temperature (MCSST) and Cross Product Sea Surface Temperature (CPSSR) are computed from imagery of the Advanced Very High Resolution Radiometer (AVHRR) for five fortnights in 1984/85. They demonstrate systematic latitudinal variations and regional extremes of the differences with greatest root mean square values of 0.7K between MCSST and SMSST found at low latitudes. Mean differences range from 0.1K between CPSST and SMSST to 0.45K between MCSST and SMSST. A part of the differences might be attributed to the skin cooling at the sea surface. A parameterization of the bulk skin temperature difference is derived from in situ field measurements. This can be used to find a relation between satellite measured bulk and skin temperatures. ESA

N93-21633# Joint Research Centre of the European Communities, Ispra (Italy). Remote Sensing Applications Inst.

SEASONAL SST AND UPWELLING INDICES ALONG THE NORTHWEST AFRICAN COAST **c48**

Leo Nykjaer and Lieve VanCamp *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 347-351 (For primary document see N93-21569 07-42)

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The 3400 NOAA global area coverage satellite images covering the northwest African upwelling area were processed to sea surface temperature (SST) maps. An SST upwelling index was computed and is analyzed for seasonal and spatial variabilities. An Ekman upwelling index was computed from the large scale wind field and the two indices are compared. The analysis shows a consistent agreement at the large scale, but complicated and often diverse relationship at mesoscale. ESA

N93-21634# Telespazio, S.p.A., Rome (Italy).

SURFACE CIRCULATION IN THE ADRIATIC SEA AS OBSERVED BY AVHRR **c48**

G. Borzelli, S. Marullo, R. Ligi, and P. E. LaViolette (Mississippi State Univ., Mississippi State.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 353-359 (For primary document see N93-21569 07-42)

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The surface summer circulation in the Adriatic Sea was studied using a time series of 122 NOAA passes covering a period from 8 Jul. - 12 Sep. 1991. Because no interest was focused on temperature absolute value, and because split window techniques may often mask weak thermal patterns, atmospheric corrections were avoided. Satellite data clearly revealed the very turbulent structure of the circulation in middle Adriatic and the violent evolution of coastal jets along both Italian and Yugoslavian sides. The observed instabilities often evolve into eddies that fill the north and middle Adriatic Sea. The apparent absence of winds such to justify those structures opens a very interesting and intriguing problem about energy sources for the generation of the eddies and for their stability. ESA

N93-21635# Lund Univ. (Sweden). Dept. of Water Resources Engineering.

A STUDY OF THE THERMAL BAR IN LAKE LADOGA (RUSSIA) USING NOAA-AVHRR DATA **c43**

Lennart Joensson and Joakim Malm *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 361-365 Sponsored by Swedish Natural Science Research Council, Lisshed's Foundation, and Royal Swedish Academy of Sciences (For primary document see N93-21569 07-42)

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A study of the thermal bar and its temporal behavior in Lake Ladoga, Russia, using NOAA AVHRR CH4/CH5 data is presented. During spring and autumn a special thermohydrodynamic phenomenon, called thermal bar, can be observed in dimictic lakes. The thermal bar is a zone of mixing that separates waters with temperatures above and below 4C. Its practical importance is due to the possibility that it might isolate the nearshore region from the offshore region (as seen from the thermal bar), which may cause a serious pollution problem along the beach. The satellite derived water surface temperature distributions, calibrated with some in situ temperature data, show that the thermal bar progresses from the southern shallow region to the deep northern part of the lake. The thermal bar progression during Spring, obtained from sequences of satellite images, is compared with predictions from a simple theoretical model. The comparison shows a good agreement between satellite derived and model predicted thermal bar locations. ESA

N93-21636# Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Atmospheric Research Div.

INTERCOMPARISON OF SATELLITE-DERIVED SEA SURFACE TEMPERATURES **c43**

I. J. Barton, A. M. Zavody (Rutherford High Energy Lab., Chilton, England.), A. J. Prata, D. T. Llewellyn-Jones (Rutherford High Energy Lab., Chilton, England.), P. Bailey (Rutherford High Energy Lab., Chilton, England.), R. P. Cechet, M. R. Gorman (Rutherford High Energy Lab., Chilton, England.), P. Kent (Rutherford High Energy Lab., Chilton, England.), D. J. Lee (Rutherford High Energy Lab., Chilton, England.), and C. T. Mutlow et al *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 367-372 (For primary document see N93-21569 07-42)

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As part of the geophysical validation campaign of the Along Track Scanning Radiometer (ATSR) several ship cruises were undertaken in the Coral Sea off the northeast coast of Australia. Ship mounted infrared radiometers were used to measure the skin temperature of the ocean surface while more conventional means supplied estimates of the bulk temperature. A single case study comparison between AVHRR, ATSR and ship measurements is presented. A preliminary assessment of the ATSR performance suggests that the instrument will meet its design goal of a global sea surface temperature accuracy of 0.3K. ESA

N93-21637# Commonwealth Scientific and Industrial Research Organization, Mordialoc (Australia). Atmospheric Research Div.

GENERATION AND DISTRIBUTION OF REMOTELY-SENSED SEA SURFACE TEMPERATURE IMAGES **c43**

A. C. Dilley, C. C. Elsum, M. Edwards, and I. J. Barton *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 373-375 (For primary document see N93-21569 07-42)

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The provision of satellite based Sea Surface Temperature (SST) charts to research organizations and fishing interests around Australia is reported. The charts are generated on the basis of measurements made by the Advanced Very High Resolution Radiometer (AVHRR) carried on the NOAA series of polar orbiting satellites. Data from this 5 band scanning radiometer are received and processed to produce images of SST quantized in 12 to 0.5C levels. SST image files can be downloaded to remotely located PCs using standard telephone services and thence written as maps on a color plotter. The processing is fully automated and operates at speeds which allow users to view a sea surface chart within 360 minutes of a satellite overflight. One important application is the use of charts by fishermen to identify areas in which several species of pelagic fish are known to aggregate in commercial numbers. ESA

N93-21638# Hamburg Univ. (Germany). Inst. fuer Meereskunde.
SATELLITE DATA ASSIMILATION IN THE WAVE MODEL 3G-WAM **c43**

E. Bauer, K. Hasselmann (Max-Planck-Inst. fuer Meteorologie, Hamburg, Germany.), and I. R. Young (New South Wales Univ., Campbell, Australia.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 377-380 (For primary document see N93-21569 07-42)
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A number of hindcast experiments with the third generation wave model 3G-WAM were carried out during the Seasat period to test the mutual consistency of wind and wave data provided by Seasat scatterometer, altimeter and SAR (Synthetic Aperture Radar) sensors. Generally the wave model data are reasonably consistent with altimeter wave heights. In order to reduce occasional regional deviations between observed wave information and simulated spectral wave energy density an assimilation method is developed to locate and estimate the wind corrections responsible for the wave data deviations. The assimilation system is tested under various situations and is currently being prepared for application to the ERS-1 SAR wave data. Intercomparison studies of 3G-WAM wave model hindcasts were generally reasonably consistent with observed altimeter wave heights. Regional discrepancies in the wave fields could be related in most cases to shortcomings in the analyzed friction velocity fields. The proposed assimilation scheme yields nonlocal friction velocity corrections at the positions of maximal influence in the observed wave data. In various test cases the assimilation procedure was able to correct wind errors of the order of 20 reasonably well from nonlocal wave measurements. ESA

N93-21639# Hamburg Univ. (Germany). Inst. fuer Meereskunde.
GLOBAL VALIDATION OF THE WAVE MODEL WAM USING GEOSAT WAVE HEIGHT DATA **c43**

Roland Romeiser *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 381-385 (For primary document see N93-21569 07-42)
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A global verification study of the WAM model over a full one year period is presented. The significant wave heights hindcast for 1988 are compared with measurements obtained by the Geosat radar altimeter. Global maps of monthly averaged wave heights derived from the WAM model and Geosat data are compared with each other. The intercomparison is complemented by a statistical analysis. Although a very good correlation is found in general, significant regional and seasonal differences are evident, which can also seen in a video animation of daily wave height maps. ESA

N93-21640# Alenia Spazio S.p.A., Rome (Italy).
SPACE RADAR ALTIMETRY DEVELOPMENT FROM OCEAN MONITORING TO LAND TOPOGRAPHY **c43**

G. Levrini, F. S. Rubertone, and R. Somma *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 387-392 (For primary document see N93-21569 07-42)
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The evolution of radar altimetry capability from monitoring of the ocean state to global coverage missions though ERS-1 and RA-2 instruments is presented. ERS-1 was launched on 17 Jul. 1991. RA-2 is scheduled for the First European Polar Mission in 1998. Although innovative in concept, RA-2 exploits many design features and some hardware units from the ERS-1 RA (Radar Altimeter), thus achieving improved performance over the oceans and measuring land topography. ESA

N93-21641# Nansen Remote Sensing Center, Bergen (Norway).
PRELIMINARY RESULTS OF ALTIMETER DATA ANALYSIS FOR STUDYING THE WATER EXCHANGE BETWEEN THE ATLANTIC OCEAN AND THE NORDIC SEAS **c48**

P. Samuel, J. A. Johannessen, and O. M. Johannessen *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmospheric and Ocean Forecasting 1992 p 393-39 (For primary document see N93-21569 07-42)
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Nearly two years of Geosat GEMT2-GDR's were analyzed to study the water exchange between the Atlantic and the Nordic Seas. Tidal elevations from a regional model were used to correct the altimetric heights and crossover adjustment was used to reduce orbit errors before computing root mean square sea surface height anomalies. Mean sea level from an ocean circulation model was used to compute an approximation to the geoid and subsequently absolute dynamic sea level was calculated from the altimetric heights. Geostrophic velocities were computed and seasonal variations in the circulation patterns were examined. A reliable tidal model is concluded to be critical, and methods to filter out noise from the signal are shown to be of utmost importance in low energy regimes such as the present study area. ESA

N93-21726# Department of Energy, Washington, DC. Engineering and Geosciences Div.
SUMMARIES OF FY 1992 GEOSCIENCES RESEARCH
Dec. 1992 165 p
(DE93-004826; DOE/ER-0573P) Avail: CASI HC A08/MF A02

The Department of Energy supports research in the geosciences in order to provide a sound foundation of fundamental knowledge in those areas of the geosciences that are germane to the Department of Energy's many missions. The Division of Engineering and Geosciences, part of the Office of Basic Energy Sciences of the Office of Energy Research, supports the Geosciences Research Program. The participants in this program include Department of Energy laboratories, academic institutions, and other governmental agencies. These activities are formalized by a contract or grant between the Department of Energy and the organization performing the work, providing funds for salaries, equipment, research materials, and overhead. The summaries in this document, prepared by the investigators, describe the scope of the individual programs. The Geosciences Research Program includes research in geophysics, geochemistry, resource evaluation, solar-terrestrial interactions and their subdivisions including Earth dynamics, properties of Earth materials, rock mechanics, underground imaging, rock-fluid interactions, continental scientific drilling, geochemical transport, solar/atmospheric physics, and modeling, with emphasis on the interdisciplinary areas. All such research is related either directly or indirectly to the Department of Energy's long-range technological needs. DOE

N93-20070*# Wisconsin Univ., Madison.
INTERACTIVE ACCESS AND MANAGEMENT FOR FOUR-DIMENSIONAL ENVIRONMENTAL DATA SETS USING McIDAS
William L. Hibbard and Gregory J. Tripoli *In* NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 11-14 (For primary document see N93-20067 07-47)
Avail: CASI HC A01/MF A02

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N93-19967# Army Topographic Engineering Center, Fort Belvoir, VA.
FEATURE MAPPING IN A PHOTOGRAMMETRIC GIS
Roger O. Brown 23 Nov. 1992 9 p
(AD-A258595; TEC-R-194) Avail: CASI HC A02/MF A01

The U.S. Army Corps of Engineers Topographic Engineering Center (TEC) has assembled a Terrain Information Extraction System (TIES). The TIES uses photogrammetric Geographic Information System (GIS) technology for digital image-based mapping (Brown, 1991). The TIES is a modular system for generating digital terrain data (Desmond, Edwards, 1990). Components of the TIES exchange Digital Topographic Data (DTD) by a

Feature Map Exchange Format (FMEF). The TIES-FMEF is described. GRA

N93-19979*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.

REMOTE SENSING OF EARTH TERRAIN Semiannual Progress Report, 1 Jul. - 31 Dec. 1990

Herng-Aung Yueh and Jin Au Kong 31 Dec. 1991 25 p

(Grant NAGw-1617)

(NASA-CR-192139; NAS 1.26:192139) Avail: CASI HC A03/MF A01

In remote sensing, the encountered geophysical media such as agricultural canopy, forest, snow, or ice are inhomogeneous and contain scatters in a random manner. Furthermore, weather conditions such as fog, mist, or snow cover can intervene the electromagnetic observation of the remotely sensed media. In the modelling of such media accounting for the weather effects, a multi-layer random medium model has been developed. The scattering effects of the random media are described by three-dimensional correlation functions with variances and correlation lengths corresponding to the fluctuation strengths and the physical geometry of the inhomogeneities, respectively. With proper consideration of the dyadic Green's function and its singularities, the strong fluctuation theory is used to calculate the effective permittivities which account for the modification of the wave speed and attenuation in the presence of the scatters. The distorted Born approximation is then applied to obtain the correlations of the scattered fields. From the correlation of the scattered field, calculated is the complete set of scattering coefficients for polarimetric radar observation or brightness temperature in passive radiometer applications. In the remote sensing of terrestrial ecosystems, the development of microwave remote sensing technology and the potential of SAR to measure vegetation structure and biomass have increased effort to conduct experimental and theoretical researches on the interactions between microwave and vegetation canopies. The overall objective is to develop inversion algorithms to retrieve biophysical parameters from radar data. In this perspective, theoretical models and experimental data are methodically interconnected in the following manner: Due to the complexity of the interactions involved, all theoretical models have limited domains of validity; the proposed solution is to use theoretical models, which is validated by experiments, to establish the region in which the radar response is most sensitive to the parameters of interest; theoretically simulated data will be used to generate simple invertible models over the region. For applications to the remote sensing of sea ice, the developed theoretical models need to be tested with experimental measurements. With measured ground truth such as ice thickness, temperature, salinity, and structure, input parameters to the theoretical models can be obtained to calculate the polarimetric scattering coefficients for radars or brightness temperature for radiometers and then compare theoretical results with experimental data. Validated models will play an important role in the interpretation and classification of ice in monitoring global ice cover from space borne remote sensors in the future. We present an inversion algorithm based on a recently developed inversion method referred to as the Renormalized Source-Type Integral Equation approach. The objective of this method is to overcome some of the limitations and difficulties of the iterative Born technique. It recasts the inversion, which is nonlinear in nature, in terms of the solution of a set of linear equations; however, the final inversion equation is still nonlinear. The derived inversion equation is an exact equation which sums up the iterative Neuman (or Born) series in a closed form and, thus, is a valid representation even in the case when the Born series diverges; hence, the name Renormalized Source-Type Integral Equation Approach. Author

N93-19983# Spectral Sciences, Inc., Burlington, MA.

DATA ANALYSIS FOR BARK AND LEAF REFLECTANCE MEASUREMENTS Report No. 4

J. H. Gruninger, D. C. Robertson, and M. M. Pervaiz Jun. 1992 54 p

(Contract F19628-89-C-0128)

(AD-A258598; AD-E201314; SSI-TR-197; PL-TR-92-2151) Avail: CASI HC A04/MF A01

This study addresses the incorporation of the effects associated with natural environments and backgrounds in the simulation models which are essential to the development of smart weapons. The effects of leaves and bark in the visible and IR spectral regions is discussed and a computational model is presented for the bi-directional reflectance (BRDF) measurement carried out. A singular value decomposition (SVD) technique is used to justify an important model assumption, factorization of the spectral and angular dependencies into separate product functions. An empirical reflectance model, previously developed, is applied to these data. Since the leaves are translucent at shorter wavelengths, this model is expanded to include a very simple description of the directional transmittance. GRA

N93-20322# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

USE OF FEATURES DERIVED FROM CLASS PROPORTIONS IN A PIXEL FOR THE MULTISPECTRAL CLASSIFICATION OF REMOTE SENSING IMAGES [UTILIZACAO DE ATRIBUTOS DERIVADOS DE PROPORCOES DE CLASSES DENTRO DE UM ELEMENTO DE RESOLUCAO DE IMAGEM (PIXEL) NA CLASSIFICACAO MULTIESPECTRAL DE IMAGENS DE SENSORIAMENTO REMOTO]

Ana Paula Dutra deAguiar Jun. 1991 214 p In PORTUGESE

(INPE-5306-TDI/456) Avail: CASI HC A10/MF A03

The spectral energy collected by the remote sensing instrumentation is the integration, called mixture, of the energy reflected or emitted by the objects, called primary components of the mixture, contained in a picture element. The land use classes in a scene can be described in terms of these components proportions, especially for forest targets. The effect obtained in the automatic classification process when utilizing synthetic bands derived from components proportions in each pixel is analyzed. A Linear Mixing Model is adopted and the estimated proportions are obtained by the use of the Constrained Least Squares and Weighted Least Squares methods. The Landsat TM images used for the tests correspond to two reforested areas denominated 'ITAPEVA' and 'MOGI-GUACU'. The analysis of the classification process is based on the Maximum Likelihood Algorithm using the gaussian hypothesis, and on methods of dimensionality reduction frequently employed in remote sensing. The obtained results show that, in general, by using a substitute attribute set (formed by the addition of synthetic bands to the originals or only by the synthetic bands), a greater compression performance under the Principal Components and Canonical Analysis transformations is obtained. However, no significant improvement in the estimation of the average performance nor in the J-M Distance values between classes was obtained. In spite of this fact, the qualitative analysis of the thematic images provided important results: (1) for the analyzed images it is possible to conclude that one should not use the substitute set composed by the addition of the synthetic bands to the originals; (2) the best results are obtained by utilizing the synthetic bands only, provided that they are generated from the components which adequately represent classes in the scene and such that their proportions indicate the target structural differences. One observes, in this way, the importance of shade as a primary component for forest targets. The use of the synthetic bands only can be seen as a method for reducing the feature space comparable to the methods usually employed in remote sensing. The synthetic bands can also be useful for manual interpretation, due to their excellent visual effect produced by color composites and also because their information represents physical concepts (proportions) more easily assimilated than the classes spectral signatures. Author

N93-20401# Naval Oceanographic and Atmospheric Research Lab., Monterey, CA.

A HORIZONTAL REFRACTIVITY DEPICTION PRODUCT: AN EVALUATION Final Report

G. N. Vogel Jul. 1992 47 p

(AD-A258738; NOARL-TN-284) Avail: CASI HC A03/MF A01

The results from an independent validation of the Naval Western Oceanography Center (NWOC) Horizontal Refractivity Depiction (HRO) product, based on a 12 month North Pacific data set, are presented. The average capability of the HRO product (analysis and 36 hr prognosis) in correctly assessing observed refractive structure (either ducting or nonducting) was near 65 percent; HRO forecasts were reliable 79 percent of the time. Based on the Hanssen and Kuipers skill score (the difference between the hit and false alarm rates), the capabilities of the HRO product in the assessment and short-range forecasting of ducting were determined to be statistically better than those using an electromagnetic propagation conditions climatology. Any potential operational use of the NWOC HRD product in regions climatically distinct from the eastern North Pacific would likely require some modification of existing forecast thumbrules. The implementation of an automated synoptic-satellite inference rule base (as

per an expert system) for the HRD, which would likely result in a more objective and consistent refractivity product, is recommended. GRA

N93-20528# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany).
REPORTS ON CARTOGRAPHY AND GEODESY, SERIES 1, NUMBER 106 [NACHRICHTEN AUS DEM KARTEN- UND VERMESSUNGSWESEN. REIHE 1, HEFT NR 106]
1991 142 p In GERMAN
(ETN-93-92583) Avail: CASI HC A07/MF A02

The following subjects were covered: the methods used in the automated system of a German cartographic company, application potentialities for automatic digitization, processes of cartographic generalization in connection with the derivation of Digital Cartographic Models (DCM) from Digital Landscape Models (DLM), the development of a topographic information system, a general overview of the use of Personal Computers (PC's) for clearcut applications, the integration of low cost PC systems in the production process of cartographic photogrammetric data gathering and data processing, thematic maps as data bank objects, tasks and development of the geoinformation system within a regional climatic project, laser scanning technology as a procedure for the acquisition of cartographic data, and a survey of geographic data models. For individual titles, see N93-20529 through N93-20540.

N93-20529# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany).
AUTOMATIZED CARTOGRAPHY, USING THE MITTELDEUTSCHEN KARTOGRAPHIE AND DRUCK GMBH SYSTEM [AUTOMATISIERTE KARTENHERSTELLUNG MIT DEM SYSTEM DER MITTELDEUTSCHEN KARTOGRAPHIE UND DRUCK GMBH]
Steffen Bothe, Andreas Domaske, Dieter Hebenstreit, Wolfgang Hildebrandt, and Peter Schmidt *In its* Reports on Cartography and Geodesy, Series 1, Number 106 1991 p 7-18 In GERMAN (For primary document see N93-20528 07-43)
Avail: CASI HC A03/MF A02

Results are given for the following: digitizing on the display, including automatic steps, automatic feature recognition by means of the evaluation of cellular lists, and the layer referred symbolization for the production of the cartographic representation. Results of tests are reported. The tests made use of the existing technical equipment. ESA

N93-20530# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany).
DEVELOPMENT OF AN AUTOMATED CARTOGRAPHIC SYSTEM [EIN WEG AUTOMATISIERTER KARTENHERSTELLUNG]
Peter Herrmann *In its* Reports on Cartography and Geodesy, Series 1, Number 106 1991 p 19-25 In GERMAN (For primary document see N93-20528 07-43)
Avail: CASI HC A02/MF A02

The following aspects of the system are described: production of originals, scanning, automated feature recognition, interactive digitizing, checking of digitizing results, symbolization, edition, and output. The model for the information basis is object related and representation oriented. It is shown that it is possible to produce films for printing originals of topographic maps in the original scale. ESA

N93-20531# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany).
APPLICATION POSSIBILITIES FOR AUTOMATED DIGITIZING [ANWENDUNGSMOEGLICHKEITEN DER AUTOMATISCHEN DIGITALISIERUNG]
Andreas Illert *In its* Reports on Cartography and Geodesy, Series 1, Number 106 1991 p 27-34 In GERMAN (For primary document see N93-20528 07-43)
Avail: CASI HC A02/MF A02

Three applications of automatic data capture from maps are described. The scope of application includes simple and comprehensive tasks in the field of cartographic pattern recognition. The three examples presented show that a programmation of specific strategies and algorithms is required for every recognition problem. ESA

N93-20532# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany).
COMPUTER AIDED CARTOGRAPHIC GENERALIZATION FOR THE DCM DERIVATION, WITH REGARD TO FEATURE DISPLACEMENT [ZUR AUTOMATIONSGESTUERTZTEN KARTOGRAPHISCHEN GENERALISIERUNG BEI DER DKM-BILDUNG UNTER BESONDERER BERUECKSICHTIGUNG DER VERDRAENGUNG]
Ernst Jaeger *In its* Reports on Cartography and Geodesy, Series 1, Number 106 1991 p 35-52 In GERMAN (For primary document see N93-20528 07-43)
Avail: CASI HC A03/MF A02

The general case of the derivation of Digital Cartographic Models (DCM's) out of Digital Landscape Models (DLM's) by process of symbolization is to include processes of cartographic generalization. A computer aided method of feature displacement is introduced using the raster data format. Based on a hierarchy of features, for each feature causing displacements of other features, an individual displacement information matrix is computed by using special quantified circular templates. Rule based 'if then procedures' ensure the recognition and correct treatment of special feature situations. Only high speed computers are able to master the raster based algorithms within an acceptable range of time. ESA

N93-20533# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany).
ATKIS: THE INTRODUCTION PHASE AT IfAG [ATKIS: DIE EINFUEHRUNGSPHASE BEIM IfAG]
Heinrich Jochemczyk *In its* Reports on Cartography and Geodesy, Series 1, Number 106 1991 p 53-64 In GERMAN (For primary document see N93-20528 07-43)
Avail: CASI HC A03/MF A02

A topographic cartographic information system for the scales 1:200,000 and 1:1,000,000 is described. This system is being established within the scope of the official topographic cartographic information system (ATKIS) at the Institute for Applied Geodesy (IfAG), where extensive experience in vector and raster data processing is available. ESA

N93-20534# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany).
THE ECONOMIC USE OF PC FOR CARTOGRAPHIC DISTRIBUTED TASKS [DER PC ZUM PREISWERTEN EINSATZ FUER VERTEILTE AUFGABEN IN DER KARTOGRAPHIE]
Juergen Kunsemueller *In its* Reports on Cartography and Geodesy, Series 1, Number 106 1991 p 65-70 In GERMAN (For primary document see N93-20528 07-43)
Avail: CASI HC A02/MF A02

A general overview about the use of personal computers for clearcut applications is given. The necessary integration for automation is to be done via Local Area Network (LAN). An easy process of familiarization with automated controlled methods is achieved. The use of partial applications is economic, and a cost efficient extension into the final solution is possible. ESA

N93-20535# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany).
THE IMPORTANCE OF THE PC IN THE CARTOGRAPHIC-PHOTOGRAMMETRIC SERVICE FIELD [DIE BEDEUTUNG DES PC IM KARTOGRAPHISCH-PHOTOIGRAMMLETRISZCHEN DIENSTLEISTUNGBEREICH]
Uwe Meyer and Ralf Schroth *In its* Reports on Cartography and Geodesy, Series 1, Number 106 1991 p 71-81 In GERMAN (For primary document see N93-20528 07-43)
Avail: CASI HC A03/MF A02

It is shown that it is possible to integrate low cost PC (Personal Computer) systems in the production process of cartographic photogrammetric data gathering and data processing. PC's with different hardware configurations are used within software development for the user environment, within digitization of maps up to data gathering and data analysis for geographic information systems. They are used in photogrammetry, in photo flight planning, aerotriangulation and photogrammetric data recording with different systems. ESA

N93-20536# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany).
THEMATIC MAPS AS DATA BANK OBJECTS [THEMATISCHE KARTEN ALS DATENBANKOBJEKTE]
Karl Neumann *In its* Reports on Cartography and Geodesy, Series 1, Number 106 1991 p 83-94 In GERMAN (For primary document see N93-20528 07-43)
Avail: CASI HC A03/MF A02

A survey of well known data models is given. A conceptual model for the 'thematic maps' object class is presented in terms of an Extended Entity Relationship (EER) model. The transformation of the EER model into the relational model is sketched. ESA

N93-20537# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany).
DOCUMENTATION AND BIBLIOGRAPHIC ANALYSIS IN THE FRAMEWORK OF THE ATKIS GENERALIZATION [LITERATURDOKUMENTATION UND -ANALYSE IM RAHMEN DER ATKIS-GENERALISIERUNG]
Johannes Schoppmeyer and Maren Beines *In its* Reports on Cartography and Geodesy, Series 1, Number 106 1991 p 95-104 In GERMAN (For primary document see N93-20528 07-43)
Avail: CASI HC A02/MF A02

The structure and evaluation of a bibliographic documentation in computer aided generalization is reported, with a view to developing the concept of a computer aided generalization system, in order to derive Digital Cartographic Models (DCM's) from Digital Landscape Models (DLM's), in the framework of the official topographic cartographic information system (ATKIS). ESA

N93-20538# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany).
TASKS AND CONSTRUCTION OF THE GEO-INFORMATION SYSTEM WITHIN THE REGIONAL CLIMATIC PROJECT (REKLIP) IN THE UPPER RHINE VALLEY (GERMANY) [AUFGABEN UND AUFBAU DES GEO-INFORMATIONSSYSTEMS INNERHALB DES REGIO-KLIMA-PROJEKTS (REKLIP) IM OBERRHEINGRABEN]
Gerhard Schweinfurth *In its* Reports on Cartography and Geodesy, Series 1, Number 106 1991 p 105-113 In GERMAN (For primary document see N93-20528 07-43)
Avail: CASI HC A02/MF A02

It is shown that the 'regional climatic project' is a user orientated climate analysis to give information in the spatial and chronological diffusion of all important climate parameters. Ground and satellite data, and highly developed models are used. A Geographic Information System (GIS) is used, which is divided into a central system and into several subsystems. Communication is done via INTERNET. The tasks of the central system are the following: transformation and storage of all regional data in a unique coordinate system, complex data analysis and model simulation, and graphical presentation of data by high standards. The subsystems are responsible for their specific data input, the data transfer to the central, system and their own data analysis. ESA

N93-20539# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany).
SCANNER TECHNOLOGY AS AN ALTERNATIVE TO MANUAL DIGITIZING. THE DATA ACQUISITION OF THE 1990S [SCANNERTECHNOLOGIE ALS ALTERNATIVE ZUM HAND-DIGITALISIEREN DATENERFASSUNG DER 90ER JAHRE]
Werner Trepper *In its* Reports on Cartography and Geodesy, Series 1, Number 106 1991 p 115-121 In GERMAN (For primary document see N93-20528 07-43)
Avail: CASI HC A02/MF A02

Methods of automatizing the production of huge numbers of cartographic inventories are represented. Special emphasis is laid on the technical solution of a problem generated by the discussion with practice. A procedure for all tasks of the acquisition of cartographic data is given as a result. The processing of graphic and alphanumeric data is covered. An analog edition and a selective evaluation are parts of the modules to be chosen. The LASERSCAN system is offered from 1991. ESA

N93-20540# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany).
GEOGRAPHIC DATA MODEL: A SURVEY [GEOGRAPHISCHE DATENMODELLE: EIN UEBERBLICK]
Wigand Weber *In its* Reports on Cartography and Geodesy, Series 1, Number 106 1991 p 123-144 In GERMAN (For primary document see N93-20528 07-43)
Avail: CASI HC A03/MF A02

A survey of the characteristics of general data models and the syntaxes used to describe them are given. The peculiarities of geographic data models are pointed out: abstract geographic data types, the attribute 'geometry', and spatial relations. The essential contents of their data catalog is outlined. Criteria for the evaluation and examples of mainly object oriented geographical data model and hints to exchange formats for data of such models are given. ESA

N93-20740# Beleidscommissie Remote Sensing, Delft (Netherlands).
QUANTITATIVE REGISTRATION OF TREE VITALITY AND PHYSIOLOGICAL CHANGES WITH COLOUR-INFRARED AND MULTISPECTRAL PHOTOGRAPHY
Feb. 1992 83 p Prepared in cooperation with KLM Aerocarto, Schiphol, Netherlands
(BCRS Proj. CO-1.10; BCRS Proj. OP-2.5)
(BCRS-91-44; ISBN-90-5411-022-8; ETN-92-92846) Avail: CASI HC A05/MF A01

The main aim was to improve the assessment of tree vitality on aerial photographs. This was attempted by quantifying the interpretation procedure of the aerial photograph. The project consists of two parts: the relation between tree physiology and multispectral and color infrared aerial photography, and the registration of tree vitality and physiological changes by means of multispectral photography. Reports of both projects are presented. ESA

N93-20846# Reading Univ. (England). Natural Environmental Research Council Unit for Thematic Information Systems.
REPORT OF THE NERC UNIT FOR THEMATIC INFORMATION SYSTEMS Status Report, Nov. 1989 - Mar. 1991
1991 27 p
(Rept-1989/91; ETN-92-92759) Avail: CASI HC A03/MF A01; Reading Univ., NERC Unit for Thematic Information Systems, Dept. of Geography, P.O. Box 227, Reading, Berks RG6 2AB, England, HC

The work sponsored by the Natural Environment Research Council (NERC), concerning the NERC Unit for Thematic Information Systems (NUTIS), is summarized. The aim of the information system was to study the ways spatial environmental data should be organized in the data bases, used and displayed. The following topics are presented: handling four dimensional geocoded data, next generation remotely sensed data, data bases for image understanding system, expert system digital elevation models, geographic information systems for the environmental sciences, atmospheric correction of remotely sensed images, oceanographic spatial catalogues, ground cover proportions, image segmentation, tropical deforestation, crop monitoring, hazard monitoring. ESA

N93-20953# Beleidscommissie Remote Sensing, Delft (Netherlands).
MULTISPECTRAL AND MULTITEMPORAL AERIAL PHOTOGRAPHY AS AN AID FOR THE EVALUATION OF LAND IN REGIONS OF THE LIMAGNE RIFT VALLEY (FRANCE) [MULTISPECTRALE EN MULTITEMPORELE LUCHTFOTOGRAFIE ALS HULPMIDDEL BIJ LANDEVALUATIE VAN GEBIEDEN IN DE LIMAGNE SLENK]
M. A. Mulders (Wageningen Agricultural Univ., Netherlands.) Feb. 1992 71 p In DUTCH
(BCRS-91-29; ISBN-90-5411-018-X; ETN-93-91878) Avail: CASI HC A04/MF A01

Land evaluation for agricultural purposes was performed in the Limagne region using multispectral remote sensing. Data of multispectral aerial photographs, acquired with four filters and at three periods of acquisition, were processed. Qualitative interpretation of the aerial photographs and quantitative data processing were applied to determine the response of corn growth to difference in soil types and soil variability. It is shown that the interpretation of satellite images and multispectral aerial photographs provides much useful information for land evaluation at small and large scale, respectively. ESA

N93-20954# Beleidscommissie Remote Sensing, Delft (Netherlands).
THE USE OF THERMAL INFRARED REMOTE SENSING FOR WATER MANAGEMENT: REPORT OF THE OPERATIONAL RESEARCH Final Report [HET GEBRUIK VAN THERMISCH INFRAROOD REMOTE SENSING TEN BEHOEVE VAN WATERBEHEER: EINDRAPPORT VAN HEL OPERATIONALISERINGSONDERZOEK]
B. Roeters (Rijkswaterstaat, Delft, Netherlands.), G. N. M. Stokman (Rijkswaterstaat, Delft, Netherlands.), and H. T. C. vanStokkom Feb. 1992 35 p In DUTCH
(BCRS-91-34; RIZA-91.201X; MDLK-8915; ISBN-90-5411-019-8; ETN-93-91882) Avail: CASI HC A03/MF A01

Operational research on the use of thermal IR remote sensing for water management was carried out to establish the conditions for the effective application of this technique in daily practice. The evaluation of pilot projects shows that this technique is a valuable support for the inventory of industrial drainage, study of the effect of tidal motions on drainage, and the study of the effect of cooling water drainage on the temperature of rivers. Recommendations for the practical operational use of thermal IR remote sensing are given. ESA

N93-20960 Deutsche Geodaetische Kommission, Munich (Germany).
NATIONAL REPORT OF THE FEDERAL REPUBLIC OF GERMANY ON THE GEODETIC ACTIVITIES IN THE YEARS 1987-1991
Erik Grafarend, comp. and Klaus Schnaedelbach, comp. 1991 179 p Proceedings of the 20th International Union for Geodesy and Geophysics General Assembly, Vienna, Austria, 11-24 Aug. 1991
(Ser-B-294; ISBN-3-7696-8579-2; ETN-93-92173) Copyright Avail: Deutsche Geodaetische Kommission, D-8000 Munich 2, Marstallplatz 8, Postfach 220 002, Germany

A report reflecting the geodetic activities in Germany is presented. The contents follow the structure of the International Association of Geodesy (IAG) according to the bylaws wherein five sections with Special Study Groups (SSG) and commissions are defined. These sections cover: the positioning aspects of geodetic sciences; geodynamics; determination of the gravity field; advanced space technology such as radiosatellite techniques, satellite and lunar laser ranging, satellite altimetry, satellite to satellite tracking and satellite gradiometry; and general theory and methodology study problems related to the modeling of geodetic measurements, the mathematical analysis of the resulting equations, the statistical description of the measuring process, and the construction of numerical solutions which satisfy certain optimality criteria. The reports are short and their main function is the citation of reference sources. For individual titles, see N93-20961 through N93-20997.

N93-20961 Deutsche Geodaetische Kommission, Munich (Germany).
COMMISSION 10: CONTINENTAL NETWORKS. SUBCOMMISSION FOR THE EUROPEAN REFERENCE FRAME (EUREF)
H. Hornik *In its* National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 8-17 (For primary document see N93-20960 07-43)
Copyright Avail: Deutsche Geodaetische Kommission, D-8000 Munich 2, Marstallplatz 8, Postfach 220 002, Germany

The development of the Subcommission for the European Reference Frame (EUREF) is addressed: the European Datum 1950 (ED50), a geodetic network covering the entire European continent and extended to Africa and Asia, was improved to become the European Triangulation Network (RETrig) which was restricted to western Europe. After this was dissolved it was replaced by EUREF. The following campaigns are considered: EUREF Global Positioning System (GPS) test campaign 1989, EUREF mobile very long baseline interferometry campaign, and EUREF GPS campaign north-west 1990; GPS activities within Germany related to the EUREF are addressed and this includes the German reference network: Deutsches Referenznet (DREF), and the SEEGAU network. EUREF connections with Turkey and future plans are considered. ESA

N93-20962 Niedersaechsisches Landesverwaltungsamt, Hanover (Germany). Landesvermessung.
COMMISSION 10: CONTINENTAL NETWORKS. SUBCOMMISSION UNITED EUROPEAN LEVELLING NETWORK (UELN)
W. Augath *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 18-21 (For primary document see N93-20960 07-43)
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Specific efforts of UELN concerning the establishment of a kinematic height system for Europe are summarized and connected articles are referenced. The upgrading of the UELN design and observations is considered, giving attention to the development of a kinematic European leveling net. Progress in observation techniques for kinematic height determinations is outlined as is progress in analysis and modeling of continental kinematic height systems. ESA

N93-20963 Universitaet der Bundeswehr Muenchen, Neubiberg (Germany). Inst. fuer Astronomie und Physikalische Geodaesie.
SSG 1.73: INTEGRATED GEODESY
G. W. Hein *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 22-23 (For primary document see N93-20960 07-43)
Copyright Avail: Deutsche Geodaetische Kommission, D-8000 Munich 2, Marstallplatz 8, Postfach 220 002, Germany

Reference to papers concerning the following is made: the integrated adjustment of geodetic observations in one unified model and systems integration; the robust prediction of random effects in a mixed linear model as it is the case in an integrated adjustment for the determination of coordinates and functionals of the disturbing gravity potential as well as the consideration of stochastic prior information about the gravity field and reference ellipsoid; the use of mass point models in an integrated model and its numerical realization; a fundamental four dimensional integrated geodesy model; an extensive study on the consideration of density and seismic observations in the context of an integrated model; the increasing possibility of determining orthometric heights using CPS ellipsoidal height differences and gravity data which results from the advent of global positioning systems. The advantages of an integrated model adjustment for the height transfer over gulfs and straits; software packages. ESA

N93-20964 Kayser Threde G.m.b.H., Munich (Germany).
SSG 1.77: UTILIZATION OF INERTIAL TECHNIQUES FOR GEODESY AND SURVEYING
B. Eissfeller and D. Schroeder (Stuttgart Univ., Germany.) *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 24-27 (For primary document see N93-20960 07-43)
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Applications of inertial technology to geodesy and surveying, where the main emphasis is either placed on special applications such as inertial engineering surveying or on investigations to increase the overall accuracy of inertial positioning, are addressed. One of the most important parts of the Sonderforschungsbereich 228 'high precision navigation, integration of navigational and geodetic methods' is the sphere of inertial technology. The step from an inertial navigation system to a high precision geodetic positioning system is planned to be achieved by means of a sophisticated analysis of the inertial sensors and an improved dynamic modeling of the system. Of special interest is the coupling of the inertial data with global positioning system position fixes in order to develop a hybrid real time surveying system, suited for applications especially in the close range area. ESA

N93-20965 Universitaet der Bundeswehr Muenchen, Neubiberg (Germany).
SSG 1.79: OPTICAL INTERFEROMETRY AND SHORT RANGE DISTANCE MEASUREMENT (EDM)
H. Heister *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 28-31 (For primary document see N93-20960 07-43)
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Developments made in interferometry and Electronic Distance Measurements (EDM) are reviewed giving attention to: their accuracy, reliability, testing and field calibration. Determination and calculation of geometrical and physical corrections, and correlations of measured distances

are addressed. Of special interest are those instruments, which are conspicious for their exceptional features like accuracy, reflectorless measurement, or pulse method for high speed measurement. The application of the two color method for minimizing scale errors of distance measurements due to the uncertainty of the refractive index in air is also of importance. It is concluded that although a lot of problems like the representative determination of the refractive index in connection with absolute measurements or the improvement in range have still to be solved researchers have lost interest in this field. This may be explained by the highly developed EDM instruments on the one hand and by the emergence of other techniques (such as global positioning systems) of electronic theodolite measuring systems) on the other hand. Short range electronic distance meters have become a trusted part of standard equipment of surveyor's field parties. ESA

N93-20966 Karlsruhe Univ. (Germany). Inst. fuer Geodaesie.
SSG 1.102: VERTICAL REFERENCE SYSTEMS
B. Heck *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 32-33 (For primary document see N93-20960 07-43)
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The establishment of vertical reference systems to serve as a basis for national height systems is addressed. The classical procedure of establishing national height networks is based upon geodetic levelling, potentially including gravity information along the levelling lines. The datum of a height system has been defined by lining the network to the local mean sea level at one or a couple of fundamental tide gauge stations. Since the local mean sea level at arbitrary coastal stations generally differs from a global level surface (due to such factors as sea surface topography, wind air pressure) the vertical datums of the various national height systems cannot be considered as coincident regarding dm-precision or better. In former times this fact did not produce any trouble in practice. With the advent of modern, highly precise global measuring systems like very long base interferometry, satellite laser ranging and global positioning systems this situation has changed fundamentally. The practical need for a unique global vertical reference system for oceanographic projects, like monitoring sea level changes, study of ocean/atmosphere interactions and ocean circulation, coastal safeguard requiring a unique, internally consistent vertical datum, is stressed. ESA

N93-20967 Universitaet der Bundeswehr Muenchen, Neubiberg (Germany). Inst. fuer Astronomie und Physikalische Geodaesie.
SSG 1.105: GPS KINEMATIC POSITIONING METHODS AND APPLICATIONS
G. W. Hein *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 34-36 (For primary document see N93-20960 07-43)
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Work on the potential of Global Positioning Systems (GPS) in the kinematics mode which started in 1988 is reviewed. The development of the kinematic GPS positioning software packages TOPAS and GEONAP, which both use phase observations and special techniques for the ambiguity resolution, is addressed. Reference is made to a method for the 'ambiguity resolution on the fly' on the basis of artificial intelligence (neural networks). Rapid static techniques for the use of GPS in small scale networks, the fixing of cycle ships, and a survey of GPS positioning software, are addressed. Various investigations carried out to prove the concept ('centimeters in seconds') using a vehicle on land, in aircraft (for example to determine the position of the aerial camera at time of exposure) and on ships for the purpose of bathymetric sensors, sonar systems, seismic surveys as well as the positioning of sea bottom and of platforms on sea, are referenced. The determination of instantaneous sea surface, wave heights and ocean currents in the centimeter range using GPS in buoys and precise attitude control of ships with GPS are addressed. The study of the integration of GPS and inertial navigation systems is considered. As a consequence of the extensive research in the use of GPS phase observations, a real time software for differential navigation was developed. ESA

N93-20968 Deutsche Geodaetische Kommission, Munich (Germany).
IAG COMMISSION 8 AND COSPAR ISSC B2: INTERNATIONAL COORDINATION OF SPACE TECHNIQUES FOR GEODESY AND GEODYNAMICS (CSTG). INTRODUCTION
C. Reigber *In its* National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 38-39 (For primary document see N93-20960 07-43)
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The charter, role and organization of the commission of the international CSTG are addressed. The charter of the CSTG is to: develop links between various groups engaged in the field of space geodesy and geodynamics by various techniques, coordinate work of these groups, elaborate and propose projects implying international cooperation, follow their progress and report on their advancement and results. The role of the CSTG is to facilitate the activities of national and international groups through the collection and dissemination of information within the groups and the member countries mainly through correspondence and also through international or regional meetings and to help in setting up coordinated multinational observing projects and scientific investigation programs. CSTG operates through the CSTG executive and steering commitees as well as through the CSTG national representatives in performing the role assigned to it in the Charter. In addition, there are a number of so called 'projects' and 'subcommissions': subcommission in International Radio Interferometric Surveying (IRIS), Satellite Laser Ranging (SLR) subcommission, Global Positioning System (GPS) subcommission; Space Geodetics Measurement Sites (SGMS) subcommission, subcommission on the international Campaign for Optical Observations of Geosynchronous Satellites (COGEOS). ESA

N93-20969 Deutsche Geodaetische Kommission, Munich (Germany).
CSTG SUBCOMMISSION ON SPACE GEODETIC MEASUREMENT SITES (SGMS)
K. Kaniuth and W. Lechner *In its* National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 40-41 (For primary document see N93-20960 07-43)
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The work within the Coordination of Space Techniques for Geodesy and Geodynamics (CSTG) subcommission on Space Geodetic Measurement Sites (SGMS) is described. The history, objectives, structure and German activities in the subcommission are addressed. The CSTG promotes the development and usage of international standards for the observing sites used by permanent and transportable systems making high accuracy geodetic measurements using space related techniques such as Satellite Laser Ranging (SLR), Very Long Baseline Interferometry (VLBI) and microwave signals from spacecract, such as Global Positioning Systems (GPS), GLONASS, PRARE and DORIS. This includes recommending standardized procedures for site selection, development, monumentation, local and distant geodetic control, site occupation record keeping, and site information cataloguing. It is noted that the subcommission is concerned mainly with the development and promotion of international standards for the observing sites and not with observational or service issues. ESA

N93-20970 Bonn Univ. (Germany). Inst. fuer Geodaesie.
ACTIVITY REPORT OF THE IRIS SUBCOMMISSION IN THE PERIOD 1987-1991
J. Campbell *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 42 (For primary document see N93-20960 07-43)
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The four major network programs operated by the project IRIS (International Radio Interferometric Surveying), IRIS A (Atlantic), IRIS P (Pacific), IRIS S (South) and and IRIS intensive, are addressed giving details of the length, frequency and place of sessions. Modification and additions made to the networks are considered as are changes resulting from the development of a new domestic very long base interferometry network for the Earth rotation. Institutions which have participated in the Earth Orientation parameter series are listed as are the names of people who attended the IRIS subcommission in Aug. 1989 during the general assembly meeting of the International Association of Geodesy (IAG) at Edinburgh (Scotland). ESA

N93-20971 Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany).
GERMAN PARTICIPATION IN THE ACTIVITIES OF THE CSTG SUBCOMMISSION ON SATELLITE LASER RANGING (SLRS)
P. Wilson *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 43-48 (For primary document see N93-20960 07-43)
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The main operational and organizational activities in satelllite laser ranging over the last four years which have affected the work of the Coordination of Space Techniques for Geodesy (CSTG) subcommission are summarized and the role played by Germany in these developments is highlighted. Statistics of the annual tracking performance on Lageos (Laser Geodynamic Satellite) are presented. Other satellites receiving the attention of the global tracking network are addressed. The performance, ranging characteristics and distribution of tracking systems are discussed as are data formats, data collection, data distribution, data exchange and data analysis. The prediction of satellite orbits is addressed. A table of European mobile laser site occupational sequences from 1987 - 1990 is presented. ESA

N93-20972 Institut fuer Angewandte Geodaesie, Koetzing (Germany). Satellitenbeobachtungsstation Wettzell.
CSTG SUBCOMMISSION GPS: GPS IN GERMANY (1988-1991)91)
W. Schlueter and H. Seeger (Institut fuer Angewandte Geodaesie, Frankfurt am Main, Germany.) *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 49-61 (For primary document see N93-20960 07-43)
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International and national activities of the Coordination of Space Techniques for Geodesy and Geodynamics (CSTG) Global Positioning System (GPS) subcommission are addressed with attention being given to the role played by Germany. The application of GPS in geodesy as well as in surveying and mapping started in 1983 with the introduction of GPS positioning for second and third network densification. Multinational projects started in 1988 when a campaign was proposed covering 11 satellites or very long base interferometry observatories in western Europe in order to test GPS on a continental basis. Projects relating to various research institutes are addressed and these include the application of GPS positioning for ERS-1 mission. The use of GPS to perform practical fieldwork for land survey offices is also considered. ESA

N93-20973 Deutsche Geodaetische Kommission, Munich (Germany).
SSG 2.106: DETERMINATION OF ORBITS TO cm-ACCURACY
Ch. Reigber and J. Dow (European Space Agency. European Space Operations Center, Darmstadt, Germany.) *In its* National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 62-66 (For primary document see N93-20960 07-43)
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Requirements for accurate orbit determination for the benefit of applications in satellite geodesy and geodynamics were discussed by this Special Study Group (SSG). These include: highly accurate tracking data with good temporal and spatial distribution; continual improvement in modeling, in particular with regard to the physical modeling of gravitational and non gravitational effects; proper spacecraft engineering or optimum modeling of the spacecraft's geometrical and physical properties; highly accurate and efficient precision orbit determination software systems, being used in workstations, vector machines and other large scale computers. ESA

N93-20974 Stuttgart Univ. (Germany). Inst. fuer Geodaesie.
SSG 2.107: GRAVITY FIELD DETERMINATION BY SATELLI TE GRAVITY-GRADIOMETRY
Nguyen Chi Thong and B. Middel *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 67-69 (For primary document see N93-20960 07-43)
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Papers discussing the use of satellite techniques such as Satellite to Satellite Tracking (SST) or Satellite Gravity Gravimetry (SGG) to give accurate gravity information to enable the high quality description of the Earth's global gravity field are referenced. Subjects covered include: the historical development method and mechanical principles of SGG; simulation studies performed during the realization of SGG mission; instrumentation of the satellite Aristoteles, and the analysis of satellite gradiometry information. ESA

N93-20975 Technische Hochschule, Darmstadt (Germany). Inst. fuer Physikalische Geodaesie.
GRAVIMETRIC ACTIVITIES IN THE PERIOD 1986-1990, SUBMITTED TO THE INTERNATIONAL GRAVITY COMMISSION OF IAG
E. Groten *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 72-81 (For primary document see N93-20960 07-43)
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Contributions, through absolute gravity observations, to the establishment of the International Absolute Gravity Basestation Network (IAGBN) are referenced. Instrumental developments and investigations are addressed. Precise geodynamic investigations are considered and papers giving fuller details are referenced. These investigations covered precise gravity observations, time dependent gravity changes and some tidal results. Relative gravity measurements are considered with attention on high precision gravimetry, instruments, modeling, gravimetric networks and maps. Work connected with an experiment searching for eventual deviations from Newton's gravitational law is referenced. ESA

N93-20976 Karlsruhe Univ. (Germany). Inst. fuer Geodaesie.
COMMISSION 12: INTERNATIONAL GEOID COMMISSION
H.-G. Wenzel *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 82-85 (For primary document see N93-20960 07-43)
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Three large projects carried out during 1987-1991 in Germany (FRG) concerning the topics of the International Geoid Commission are summarized: the European global positioning system traverse, the 1989 gravimetric quasigeoids for the FRG and the 1991 gravimetric quasigeoid for the FRG. A number of theoretical and numerical investigations connected to geoid determination are given in the list of references. ESA

N93-20977 Bayerische Akademie der Wissenschaften, Munich (Germany). Kommission fuer de Internationale Erdmessung.
INTERNATIONAL GRAVIMETRIC BUREAU
Gerd Boedecker *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activites in the Years 1987-1991 1991 p 86-87 (For primary document see N93-20960 07-43)
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The structure and organization of the International Gravimetric Bureau (GBI) is addressed. The GBI is outside the International Association of Geodesy (IAG) structure in the strict sense, however it is closely tied to Section 3 and particularly Commission 3 'gravity' (IGC) and Commission 12 'geoid'. It is the duty of the GBI to collect, process, archive and distribute (on request) gravity data such as observations, anomalies (also mean values and maps) and reference stations. The composition and structure of the GBI data base is described. The work of the following is addressed: WG1 data processing, WG2 world gravity standards, WG5 nontidal gravity variations, WG7 computation of mean gravity anomalies. ESA

N93-20978 Universitaet der Bundeswehr Muenchen, Neubiberg (Germany). Inst. fuer Astronomie und Physikalische Geodaesie.
SSG 3.113: SPECTRAL GRAVITY FIELD MODELLING METHODS

K. Hehl *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 88-90 (For primary document see N93-20960 07-43)

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The basic tool for the success of spectral methods in geodesy, the Fast Fourier Transform (FFT), is addressed. The overall efficiency of Fourier methods for the calculation of convolution integrals lies in the fact that the convolution of two datasets in the spatial domain reduces to a simple multiapplication of spectra of both sets in the frequency domain. The computation of terrain effects based on a regular grid of heights, one of the classical applications of FFT techniques in spectral gravity field modeling methods, is considered. Papers addressing the determination of a high precision geoid in the the subdecimeter range is referenced as is that concerning the development of efficient software for the determination of the gravity field using least squares collocation. The determination of geopotential differences through the gravity influence in a first order levelling network is addressed. ESA

N93-20979 Technische Univ., Hanover (Germany). Inst. fuer Erdmessung.

SSG 4.91: LOCAL GRAVITY FIELD APPROXIMATION

H. Denker and B. Eissfeller (Kayser Threde G.m.b.H., Munich, Germany.) *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 92-96 (For primary document see N93-20960 07-43)

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The Special Study Group (SSG) studied and intercompared different local gravity field approximation techniques. Studies in geoid computations carried out at various research institutes are presented. These included the investigation of numerical integration and Fast Fourier Transform (FFT) techniques for the computation of terrain effects; the use of the highly efficient FFT techniques for the computation of a new quasigeoid of the former West Germany; a European geoid determination using the remove restore technique with point gravity field data, a digital terrain model and a global geopotential model; a theoretical and numerical study of the integrated geodesy adjustment procedure using point mass models; the development of a new version of the OPERA integrated geodesy adjustment software package; the problem of orthometric height determination by global positioning systems in combination with gravity data based on the integrated geodesy model; the possibility of gravity prediction using density and seismic data. ESA

N93-20980 Technische Univ., Berlin (Germany). Inst. fuer Geodaesie und Photogrammetrie.

SSG 4.93: WAVE PROPAGATION IN REFRACTIVE MEDIA

U. Gehlich *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 97-99 (For primary document see N93-20960 07-43)

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Investigations concerning tests and improvements of models and development of measuring methods to reduce the atmospheric influence in geodesic studies based on the propagation of electromagnetic waves are addressed. To correct the measurements, the index of refraction along the path of the ray for the wavelength used must be known. Determining parameters are, besides the chemical composition of the atmosphere, which normally is supposed to be constant and known, the thermodynamical parameters. Measurement of these along the ray path is very laborious or even impossible; on the other hand only the integral over the index of refraction along the path is necessary for the correction. Therefore the physical parameters are usually determined only for some points and the integrated influence computed from models. Furthermore the dispersive behavior of the refraction index can be used to reduce or eliminate the influence of refraction by combining measurements obtained at different wavelengths. The activities during the time interval reported concentrated on investigations concerning tests and improvements of models and development of measuring methods to reduce the atmospheric influence. The influence of atmospheric refraction on trigonometric levelling and distance measurements was investigated. The correction of global positioning system phase measurements in particular is also addressed. ESA

N93-20981 Kaiserslautern Univ. (Germany). Inst. fuer Mathematik.

SSG 4.115: MATHEMATICAL ANALYSIS OF GEODETIC BOUNDARY VALUE PROBLEM

W. Freeden and B. Heck (Karlsruhe Univ., Germany.) *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 100-105 (For primary document see N93-20960 07-43)

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Research into the Geodetic Boundary Value Problem (GBVP) in its various formulations, an outstanding subject of theoretical research in geodesy for decades, attracting practically oriented mathematicians as well as theoretically oriented geodesists, is addressed. Although in some respect practically sufficient results are available, research in this field is still in progress in view of modern computational facilities, new observation techniques and the improvement of classical observational procedures in recent years. Main advances in the past quadrenium were achieved in the analysis of overdetermined GBVP's, internal problems, and the effects of nonlinearity of the boundary operator. Most important developments were also made with respect to the formulation of the GBVP in terms of pseudodifferential operators on the boundary and with respect to the construction of approximate solutions by means of trial functions and by applications of boundary element methods. ESA

N93-20982 Technische Univ., Munich (Germany). Lehrstuhl fuer Photogrammetrie.

SSG 4.116: KINEMATIC AND DYNAMIC SYSTEM MODELLING IN GEODESY

D. Fritsch *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 106-111 (For primary document see N93-20960 07-43)

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German contributions to this Special Study Group (SSG) during 1988-1991 are reported. These concentrated on the development of modeling strategies for high dynamics systems to provide for basic theoretic knowledge of emerging systems using Global Positioning Systems (GPS) and inertial technology. While GPS is in the meantime very universal and extensively used in surveying, Inertial Navigation System (INS) could only be investigated in some pilot applications. Point positioning is an essential task of the geodetic community. With the recent advances of technology, in particular sensor developments, new concepts in data processing have to be developed to care for definite precise and reliable coordinates of points not only on the Earth surface but also in aircrafts for photogrammetric purposes. For that reason, the investigations on the behavior of kinematic and dynamic positioning should take into account different points of view depending mainly on GPS and INS data. Problems which were addressed during the quadrennium 1988-1991 and which are reported are: classification of geodetic systems (a priori information, linearly, deterministic and stochastic characteristics); system theoretic aspects (realization, reachability, observability, stability, optimality); modeling (state space representation, eigenvalue representation, alternatives); estimation methods (Kalman filtering and smoothing, adaptive and nonlinear filtering, applied system identification spectral methods). ESA

N93-20983 TerraSat, Hoehenkirchen (Germany).

SSG 4.117: OPTIMIZATION OF MODERN POSITIONING TECHNIQUES

Herbert Landau *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 112-114 (For primary document see N93-20960 07-43)

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References to optimization studies of modern positioning techniques investigated by German geodesists during 1987-1991 are given. Basically two different techniques were investigated: developments in the field of design optimization of geodetic networks with special consideration of

modern positioning techniques; investigations concerning the optimal data reduction of original observations to the geodetic relevant position information. ESA

N93-20984 Technische Univ., Munich (Germany). Inst. fuer Astronomie und Physikalische Geodaesie.

SSG 4.118: INVERSE GEODETIC PROBLEMS

K. H. Ilk *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 115-123 (For primary document see N93-20960 07-43)

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The importance of inverse and improperly posed problems in physical geodesy is addressed. If the parameters of a system cannot be measured directly but only computed from indirect observables of this system then this problem is usually called an inverse problem. Some problems also suffer from the fact that a unique solution does not exist. These kind of problems are called improperly posed. In geodesy improperly posed problems occur for instance in connection with downward continuation of gravity information from satellite or aerial altitudes down to the Earth's surface or in case of investigations related to the Earth's interior based on gravity information at the Earth's surface or outside the attracting masses. From the point of view of modeling, the Earth embedded in the planetary system, should be considered as one physical system, modeled by a large number of parameters, which are not accessible to direct measurement. The trial to decompose this very complex problem in separate smaller problems will be artificial in any case. Nevertheless, for methodological reasons it might be helpful to classify geodetic inverse problems roughly in the following way. But it must be pointed out that no clearly defined border lines exist. For simplification, in general the gravitational field will be focused upon, disregarding the fact that the other geophysical fields are as important as the gravity field. The following problems and their methodological treatment are addressed: inverse problems to gravity smoothing; gravity inversion problems; dynamic inversion problems. ESA

N93-20985 Stuttgart Univ. (Germany). Inst. fuer Geodaesie.

SSG 4.119: RELATIVISTIC EFFECTS IN GEODESY

E. W. Grafarend *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 124-130 (For primary document see N93-20960 07-43)

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A review of relativistic effects in geodesy is given which is divided into three parts. In the first part the complete space time metric defining the multipoles of an inhomogeneous Earth referring to the Earth rotation including nutation, precession, and polar motion, the Earth tides and the relativistic viscoelastic model of the Earth is treated. The reference systems have to be defined. The second part addresses the generation of equations of the four dimensional geodesic using the Christoffel symbols of the metric derived in part one. Applied to the computation of satellite orbit (global positioning systems, Aristoteles, Lageos, ERS-1) several relativistic effects disturbing the Kepler orbit were computed. The third part related to time systems and the propagation of electromagnetic waves between an Earth bounded satellite (passing the refractive dispersive atmosphere) and a topocentric receiver. All geodetic observational equations were modeled within the framework of general relativity, namely by means of light-like geodesics. The properties of the refractive, dispersive medium, and the 4-velocity of the reference systems were incorporated. ESA

N93-20986 Universitaet der Bundeswehr Muenchen, Neubiberg (Germany). Lehrstuhl fuer Ingenieurgeodaesie.

SSG 4.120: NON-LINEAR ADJUSTMENT

W. Caspary, P. Lohse (Stuttgart Univ., Germany.), and J. VanMierlo (Karlsruhe Univ., Germany.) *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 131-133 (For primary document see N93-20960 07-43)

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The objectives of this International Association of Geodesy (IAG) Special Study Group (SSG) on linear adjustment were to examine how performance measures of estimators vary when the actual model differs from the assumed model, to evaluate the performance of numerical methods for computing the desired estimates, and to devise, test, and evaluate methods which are robust. Work carried out in the last four years with respect to the following research topics is reported and references to further information are given: nonlinear statistical inference, numerical methods for nonlinear optimization, and robust statistics. Work related to the topic of perturbation analysis for linear inference were omitted by way of a more rigorous interpretation of the term nonlinear adjustment. ESA

N93-20987 Observatorium Schiltach, Wolfach (Germany).

COMMISSION 5: EARTH TIDES

Walter Zuern *In* Deustche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 136-140 (For primary document see N93-20960 07-43)

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The most important publications on the topic 'Earth tides' are listed. It is noted that this list may well be incomplete and that there are further publications which would be equally worthy of note in this report. ESA

N93-20988 Niedersaechsisches Landesverwaltungsamt, Hanover (Germany). Landesvermessung.

COMMISSION 7: RECENT CRUSTAL MOVEMENTS

W. Augath and B. Heck (Karlsruhe Univ., Germany.) *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 141-148 (For primary document see N93-20960 07-43)

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Means of modeling horizontal and vertical crustal movements through geodetic terrestrial and space geodetic observations are addressed and related publications are cited. Achievements in the instrumental and observational part as well as on the modeling side are considered. Significant progress has been made in the development of functional and stochastic models for processing geodetic observables larging on time, implying modern methods from mathematical statistics. Further steps have been done towards the simultaneous determination of recent crustal movements and accompanying gravity field changes by combining geometrical geodetic data with observations sensitive in respect to the gravity field. Terrestrial observations involve the precise levelling technique and repeated gravity measurements. Actual rate of plate tectonic motions and kinematical parameters have been derived from space geodetic observations like Very Long Baseline Interfeometry (VLBI) and Satellite Laser Ranging (SLR), along with other parameters of geodynamic interest which use levelling techniques and repeated gravity measurements. These space geodetic measurements provide also the means for establishing global and regional reference systems and to integrate regional and local geodetic monitoring systems into a unique reference frame; global positioning system phase observations have proceeded to become a most useful tool for densification of global monitoring networks and linking local observational data. ESA

N93-20989 Karlsruhe Univ. (Germany). Inst. fuer Geodaesie.

INTERNATIONAL CENTRE ON RECENT CRUSTAL MOVEMENTS

H. Maelzer *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 149 (For primary document see N93-20960 07-43)

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General information on the International Center on Recent Crustal Movements (ICRCM) is given including details of its organization, establishment, and members. The activities of the ICRCM are the continuation of the following: collection, storage, and distribution of bibliographical and numerical data on RCM; consultations and scientific help by establishment of monitoring networks for RCM studies and by performing the measurements and their analysis, especially aimed at the developing countries; contacts with other similar centers including exchange of information, the ICRCM activity as the CRCM secretariat, issuing the

information bulletin, and improving contacts with the CRCM subcommissions. ESA

N93-20990 Bonn Univ. (Germany). Inst. fuer Geodaesie.
INTERNATIONAL EARTH ROTATION SERVICE
J. Campbell *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 150-154 (For primary document see N93-20960 07-43)
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Institutes which agreed to form the research group for satellite geodesy in order to coordinate activities in the fields of development and application of space techniques for geodynamics are listed and their activities discussed. These activities include the monitoring of Earth rotation using the techniques of Satellite Laser Ranging (SLR), lunar laser ranging (under development), Very Long Baseline Interferometry (VLBI), and global positioning systems. A series of Earth rotation parameters derived from these observations and submitted to the International Earth Rotations Service (IERS) are considered and connected references given. ESA

N93-20991 Joint Research Centre of the European Communities, Ispra (Italy).
SSG 5.98: ATMOSPHERIC EXCITATION OF THE EARTH'S ROTATION
J. E. Suendermann *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activites in the Years 1987-1991 1991 p 155 (For primary document see N93-20960 07-43)
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Investigations of the angular momentum of the atmosphere and its fluctuations by means of circulation models for constant Earth rotation are addressed and referenced. The global angular momentum budget was analyzed in the three dimensional climate model with integration times of 100 days. The aim was to discover model effects and to study the behavior and the effect of the different torques (Coriolis, friction, and pressure) and to compare them with observations to relate globally weather situations and circulation patterns to parameters of the angular momentum budget. Mesoscale and regional studies of mountain pressure torques were also performed. ESA

N93-20992 Sternwarte Bonn (Germany).
SSG 5.99: TIDAL FRICTION AND THE EARTH'S ROTATION
P. Brosche *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 156-158 (For primary document see N93-20960 07-43)
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Basically, tidal friction is an exchange of angular momentum in the Earth-Moon system. Today, the flow runs from the rotation of the Earth into the lunar orbit. Since the latter has relatively few degrees of freedom, as compared with the Earth, precise measurements within short time intervals refer to the lunar orbit. Such measurements are predominantly made by lunar laser ranging. Measurements of the secular change in the Earth's rotation require long time scales (historical and geological) in order to hopefully average out all other variations. Theoretical efforts start from the fact that the said exchange is mediated mainly by the oceans. Therefore, the detailed understanding of the process is a challenge to theoretical oceanography. The effect of the following factors on the Earth's rotation and tidal friction are discussed: variation of the sea level; the magnetic coupling between the inner and outer parts of the solid Earth; and the atmospheric 'bulge' or 'tide' caused by the Sun's radiation. Consideration is given to the influence of the manner in which the interaction of the solid Earth tides and the ocean's tides is modeled. The ratio of the lunar and solar torque is addressed as is an attempt to model the influence of thermohaline oceanic currents within an average year. Tide predictions searched in very long baseline interferometry observations are reported. ESA

N93-20993 Karlsruhe Univ. (Germany). Inst. fuer Geodaesie.
SSG 5.122: GEODYNAMIC EFFECTS OF GLOBAL GRAVITY FIELD VARIATIONS
B. Heck *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 159-160 (For primary document see N93-20960 07-43)
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Geodynamic effects (excluding tidal phenomena) which cause globally sensible gravity field variations are discussed including such factors as tectonic plate motions, eustatic sea level changes, post glacial rebound, core mantle boundary interaction, mantle flow, and polar motion. Many of these processes affect geodetic terrestrial and space observations and can be detected from these data. In general, exogeneous and endogeneous geodynamic phenomena are accompanied by mass transport affecting the Earth's gravitational field. In addition, many global geodynamic processes have an effect on the Earth's rotation resulting in a change of the centrifugal potential on the Earth's surface; both centrifugal and gravitational potential variations combine into time variations of the Earth's gravity field. The theory of the Earth's gravity field variable in space and time is presented replacing the conventionally used conservative gravity field by a general vector field representation including nonconservative Euler and Coriolis terms. The mechanical foundation of the Earth's deformations in geometry and gravity space are reviewed. The time dependent boundary value problem is considered from which time variations of the gravity field and the surface geometry of the Earth can be determined. The contribution of the gravimetry to monitoring geodynamical effects such as tectonic plate motion is discussed. Aspects of global and regional gravity field variations and geodynamical causes and consequences are presented. ESA

N93-20994 Deutsche Geodaetische Kommission, Munich (Germany).
SSG 5.123: DEFINITION AND REALIZATION OF TERRESTRIAL REFERENCE SYSTEMS
B. Richter and P. Schwintzer *In its* National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 161-170 (For primary document see N93-20960 07-43)
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A definition of geodetic datum in the sense of the position of a reference ellipsoid within the Earth is given. Geodetic data used in Germany is described together with the German horizontal triangulation network and the German global positioning system network. Geodetic positioning and reference systems both for conventional and space techniques are described. Research on relativistic effects in geodesy concerning reference systems is addressed. The determination of Earth rotation parameters by space techniques such as very long base interferometry and by traditional techniques, and the geophysical interpretation of these parameters are discussed. Investigations of polar motion and phase angle are also addressed. Global terrestrial reference frames by satellite laser ranging to Lageos, by global positioning system measurements, and from a multisatellite tracking station solution , are discussed. ESA

N93-20995 Technische Univ., Dresden (German D.R.). Inst. fuer Planetare Geodaesie.
INTERNATIONAL GEODETIC BIBLIOGRAPHY
D. L. Stange *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 172 (For primary document see N93-20960 07-43)
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The publication of the research results of the International Association of Geodesy (IAG) Commission 6, International Geodetic Bibliography, by the National Committee of the former German Democratic Republic (GDR) since 1990 is addressed. In this period, approximately 50,000 sources have been recorded in the form of bibliographical data and abstracts. The principal cooperation partners of the National Committee were the Headquarters for the International Documentation of Geodesy (Dresden), the Leipzig Research Center and the Akademieverlag in Berlin. Within the period of time relevant for this report up to the dissolution of the National Committee of the former GDR in Oct. 1990, 26 issues of 'bibliographia

geodaetica' were published (volumes 1988 and 1989, volume 1990 up to issue 6). The Institute for Applied Geodesy (Frankfurt am Maine and Leipzig) has kindly agreed to take on the continuation of this work. ESA

N93-20996 Universitaet der Bundeswehr Muenchen, Neubiberg (Germany). Inst. fuer Vermessungskunde.
EDUCATION IN GEODESY
W. Welsch and B. Witte (Bonn Univ., Germany.) *In* Deutsche Geodaetische Kommission, National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 173-174 (For primary document see N93-20960 07-43)
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The focus of activities with regard to education in geodesy is addressed. This has been concentrated on the necessity to take into consideratiuon the remarkable advance of technology, in particular with view to geodetic measuring techniques, and the difficulty to balance the number and intensity of subjects to be taught and the time available for studies. A meeting whose aim was to determine the rank of geodetic sciences in our society within the frame of the exact, the natural sciences, and the engineering sciences is addressed and names of speakers are given. Consequently, the expectations of society, science, and profession on geodetic engineers were analyzed. Efforts were also made to find some general conclusions for geodetic curricula. A study which considered the latest developments in state of the art curricula is also addressed. An analysis was made of what professional fields the graduates of universities would choose for their profession and results are presented. ESA

N93-20997 Deutsche Geodaetische Kommission, Munich (Germany).
HISTORY OF GEODESY
H. Wolf *In its* National Report of the Federal Republic of Germany on the Geodetic Activities in the Years 1987-1991 1991 p 175-177 (For primary document see N93-20960 07-43)
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Publications concerning the development of computation methods, historical observation procedures, and historical instruments are reviewed and references given. The following are included amongst the publications: the history of the discovery of the polar motion; the historical development of the estimation theory, starting with argumentations for the least squares method; German geodetic and surveying work performed from 1939-89; methods for measuring the length of the Rhine river from Basel to Rotterdam; the development of the triangulation in East Frisland (Germany); the Stampfer screw used in levelling instruments; the connection between archaeo-astronomy and geodesy; the hypothetical character of mathematical proofs. ESA

N93-21038# Beleidscommissie Remote Sensing, Delft (Netherlands).
APPLICATION OF REMOTE SENSING FOR THE WATER MANAGEMENT IN DRENTHE (NETHERLANDS) [TOEPASSING REMOTE SENSING TEN BEHOEVE VAN HET WATERHUISHOUDINGSPLAN DRENTHE]
G. J. A. Nieuwenhuis (Winand Staring Centre, Wageningen, Netherlands.) Feb. 1992 30 p In DUTCH
(BCRS-91-42; ISBN-90-5411-023-6; ETN-93-91887) Avail: CASI HC A03/MF A01

The applicability of remote sensing for the establishment of a water management plan for the province of Drenthe was investigated. False color pictures, digital reflection pictures, and thermal pictures were analyzed, resulting in a land use map, evaporation pictures, and a hydrological description of the province. Correlations are not found between relevant geological and hydrological characteristics on the one hand and remote sensing parameters on the other hand. The description of provincial scale for the establishment of a water management plan is very global. More regional information is prepared. ESA

N93-21205# Beleidscommissie Remote Sensing, Delft (Netherlands). Programmabureau.
THE 1991-2000 NATIONAL REMOTE SENSING PROGRAM Annual Report, 30 May 1991 [NATIONAL REMOTE SENSING PROGRAMMA 1991-2000]
Feb. 1992 30 p In DUTCH
(BCRS-91-35; ISBN-90-5411-030-9; ETN-93-91883) Avail: CASI HC A03/MF A01

The long term purposes of the Netherlands national remote sensing program 1991-2000 and the strategies to finish the program within 10 years are established. The first line of the program is the continuation of the stimulation of operational applications of remote sensing in governmental services. The second line aims at the stimulation of permanent collaboration on the Netherlands. The research fields are meteorology, oceanography, tidal waters, coastal regions, inland waterways, land use, agriculture, forestry, nature management, climatology, environment research, and technology development. ESA

N93-21270# Science and Technology Agency, Tokyo (Japan).
PRE ASIA PACIFIC ISY CONFERENCE [PURE AJIA TAIHEIYOU KOKUSAI UCHUUNEN (ISY) KAIGI]
23 Mar. 1992 79 p In JAPANESE Conference held in Tokyo, Japan, 23-25 Mar. 1992 Report will also be announced as translation (NASDA-CM-183) Prepared in cooperation with Inst. of Space and Astronautical Science, Tokyo, Japan, NASDA, Tokyo, Japan, and International Space Year Association, Tokyo, Japan
(NASDA-CM-174; JTN-93-80415) Avail: CASI HC A05/MF A01

The following topics were discussed: space programs of countries in Asia Pacific region, remote sensing, satellite observation, earth resources survey, monitoring of earth environment, global change, land management, water management, ocean observation, satellite communication, and spaceborne experiment. For individual titles, see N93-21271 through N93-21287.

N93-21271# Bangladesh Space Research and Remote Sensing Organization, Dhaka.
SPACE RESEARCH AND REMOTE SENSING PROGRAMS IN BANGLADESH [BANGURADESHU NI OKERU UCHUU KENKYUU TO RIMOTO SENSHINGU KEIKAKU]
A. K. M. Fariduddin Bhuiyan *In* Science and Technology Agency, Pre Asia Pacific ISY Conference 23 Mar. 1992 p 9-12 In JAPANESE (For primary document see N93-21270 07-43)
Avail: CASI HC A01/MF A01

Major remote sensing research, development and utilization activities in SPARRSO (Space Research and Remote Sensing Organization) of Bangladesh in the following areas are presented: (1) measurement of crop and land utilization patterns, soil characteristics pattern, and so forth in agriculture; (2) meteorological observation; (3) surface water analysis, seasonal change in lake and reservoir water-level, and so forth in water resources; (4) monitoring of forestation and new deforestation in forestry; (5) quantitative data acquisition on suspended solids, ocean current, sea surface temperature, and so forth in oceanography; and (6) production of maps indicating surface characteristics in cardiography. Author (NASDA)

N93-21272# State Science and Technology Commission, Beijing (China). Dept. of Basic Research and High Technology.
INTERNATIONAL SPACE YEAR IN CHINA [CHUUKA JINMIN KYOUWAKOKU NI OKERU KOKUSAI UCHUUNEN]
Quan Lin *In* Science and Technology Agency, Pre Asia Pacific ISY Conference 23 Mar. 1992 p 13-15 In JAPANESE (For primary document see N93-21270 07-43)
Avail: CASI HC A01/MF A01

The status of remote sensing activities coducted by China are presented. Topics discussed are as follows: (1) publication of land utilization maps; (2) monitoring of flood and drought, detection and recording all process of forest fires; and (3) monitoring experiments on forestation and deforestation, suvey on land erosion, desertification on, industrial waste pollution, and cartography of desert distribution maps in nothern China. Study on space science such as research on solar-terrestrial energy transfer systems for the International Solar-Terrestrial Energy Program and other research activities in space science, and events schedules to be conducted for the International Space Year (ISY) are outlined. Author (NASDA)

N93-21273# Indonesian National Inst. of Aeronautics and Space, Jakarta.
SPACE PROGRAM IN INDONESIA [INDONESIA NI OKERU UCHUU KEIKAKU]

Ir. H. Wiryosumarto *In* Science and Technology Agency, Pre Asia Pacific ISY Conference 23 Mar. 1992 p 16-18 In JAPANESE (For primary document see N93-21270 07-43)
Avail: CASI HC A01/MF A01

Development activities of the Indonesian National Institute of Aeronautics and Space (LAPAN) in the areas of remote sensing technology application such as climatic forecasting are presented. ISY (International Space Year) activities in Indonesia are also described. Building up remote sensing data reception and processing capability has been made to meet the requirements for monitoring changes in natural resources such as land and ocean surfaces, coast line, forest, fishing sea area, farm land, and so forth to get ready for LANDSAT satellites, SPOT, and other ESA satellites. Survey on modeling Indonesian climate model is going on, and a new wind profiling radar and a large equatorial atmosphere radar are under construction and scheduled respectively in international cooperation. Author (NASDA)

N93-21274# Science and Technology Agency, Tokyo (Japan). International Space-Affairs Div.
JAPANESE SPACE ACTIVITIES [NIHON NO UCHUU KATSUDOU]
Tsuyoshi Maruyama *In its* Pre Asia Pacific ISY Conference 23 Mar. 1992 p 19-21 In JAPANESE (For primary document see N93-21270 07-43)
Avail: CASI HC A01/MF A01

Fundamental policies and major objectives of the space activities in Japan is presented. Overview of the Japan's space activities in the following areas are presented: (1) space science including moon and planet exploration, astrophysics, and solar-terrestrial science; (2) general satellite technologies developed by engineering test satellites launched in the past or those scheduled for future launch; (3) launch vehicle development including H- and M-series of launch vehicles, and future space transportation measures such as H-2 Orbiting Plane (HOPE); (4) communication and broadcasting satellites including the Communications and Broadcasting Engineering Test Satellite (COMETS); (5) earth observation satellites including geostationary meteorological and earth observation satellites including the Advanced Earth Observing Satellite (ADEOS) and the Tropical Rainfall Measuring Mission (TRMM); and (6) space environment utilization including the use of dropping tower equipment, small rocket Test Rocket-1A (TR-1A), the space shuttle, satellites, and the space station Freedom.
Author (NASDA)

N93-21275# Korea Advanced Inst. of Science and Technology, Chongryang (Republic of Korea). Satellite Technology and Research Center.
OVERVIEW OF KITSAT [KITSAT GAINEN]
Dal Choi Soon *In* Science and Technology Agency, Pre Asia Pacific ISY Conference 23 Mar. 1992 p 22-24 In JAPANESE (For primary document see N93-21270 07-43)
Avail: CASI HC A01/MF A01

An overview of the roles and plans of the Satellite Technology and Research Center in the space activities in Korea are presented. The following items about the Korea Institute of Technology Satellite-A (KITSAT-A) launched simultaneously with the Topography Experiment for Ocean Circulation (TOPEX) by an ESA Arian launch vehicle are presented: (1) major missions such as space technology acquisition and experiencing of designing, structuring and operating minisatellites; (2) specifications for orbit, power budget, frequency allocation, attitude control, machinery, onboard data systems, and module structure; and (3) experiments with KITSAT borne equipment on data transmission, Charge Coupled Device (CCD) earth imaging, digital signal processing, and cosmic radiation measuring. The KITSAT project time schedule is also presented. Author (NASDA)

N93-21276# Korea Aerospace Research Inst., Taejon (Republic of Korea). Space Research and Development Div.
KOREA SPACE PROGRAM [DAIKANMINKOKU UCHUU KEIKAKU]
Ryoo Jang-Soo *In* Science and Technology Agency, Pre Asia Pacific ISY Conference 23 Mar. 1992 p 25-26 In JAPANESE (For primary document see N93-21270 07-43)
Avail: CASI HC A01/MF A01

An overview of the missions, history, and organization of the Korea Aerospace Research Institute (KARI) is presented. The following three projects included in the Korean space program are presented: (1) KOREASAT procurement project to procure multipurpose satellites and have them launched through international tenders to be used for communication and broadcasting in Korea; (2) exploration rocket project, Korea's self-developed rocket project, conducted by KARI to observe the ozone concentration and ionosphere over the country, and conduct microgravity experiment; and (3) KITSAT (Korea Institute of Technology Satellite-A) minisatellite project undergoing joint development with the UK Surrey University to be launched by an Arian launch vehicle of piggyback type. Author (NASDA)

N93-21277# Malayan Centre for Remote Sensing, Kuala-Lampur.
SPACE PROGRAM IN MALAYSIA [MARESIA NI OKERU UCHUU KEIKAKU]
Nik Narsruddin Mahmood *In* Science and Technology Agency, Pre Asia Pacific ISY Conference 23 Mar. 1992 p 27-29 In JAPANESE (For primary document see N93-21270 07-43)
Avail: CASI HC A01/MF A01

An overview of space activities in Malaysia in the following areas is presented: (1) utilization of the INTELSAT system including INTELSAT Business Service (IBS); (2) introduction of mobile satellite communication, INMARSAT service, and improvement of communication by the use of the domestic and regional satellite Malaysian East Asian Satellite-1 (MEASAT-1) and -2; (3) receptionand processing of image data from the TIROS-N and Geostationary Meteorological Satellites (GMSs); and (4) National Remote Sensing Programme (NRSP) started to promote establishment of the Malaysian Centre for Remote Sensing (MACRES) and other activities related to remote sensing. Author (NASDA)

N93-21278# National Remote Sensing Centre, Ulaanbaatar (Mongolia).
NATIONAL SPACE PROGRAMS AND APPLICATION OF THE REMOTE SENSING DATA IN MONGOLIA [MONFORU NI OKERU KOKKA UCHUU KEIKAKU TO RIMOTO SENSHINGU DETA NO JISSAI OUYOU]
Badarch Mendbayariin *In* Science and Technology Agency, Pre Asia Pacific ISY Conference 23 Mar. 1992 p 30-33 In JAPANESE (For primary document see N93-21270 07-43)
Avail: CASI HC A01/MF A01

An overview of the remote sensing satellite data application in Mongolia is presented. The application area is as follows: (1) the operation of meteorological satellite data acquisition station in receiving data from the US and former U.S.S.R. satellites; (2) establishment and operation of the meteorological rocket exploration station; and (3) establishment of the national remote sensing center. An overview of the activities of the center in the following areas is presented: (1) development of domestic capability to examine, classify, and monitor the natural resources; (2) monitoring of natural disasters such as cyclones, drought, forest fires, hurricanes, and air pollution; and (3) examples of remote sensing data application to natural disaster monitoring, geology, hydrology, and environment control.
Author (NASDA)

N93-21279# Department of Environment and Natural Resources, Quezon City (Philippines).
STATUS OF REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM (GIS) APPLICATIONS IN THE ENVIRONMENT AND NATURAL RESOURCES (ENR) SECTOR [KAMLUPU SHIGEN (ENR) BUNYA NI OKERU RIMOTO SENSHINGU OYOBI CHIRI JOUHOU SHISUTEMU (GIS) NO OUYOU JO UKYOU]
Ricardo M. Umali *In* Science and Technology Agency, Pre Asia Pacific ISY Conference 23 Mar. 1992 p 34-35 In JAPANESE (For primary document see N93-21270 07-43)
Avail: CASI HC A01/MF A01

An overview of the Department of Environment and Natural Resources (DENR) activities through the National Mapping and Resource Information Authority (NAMRIA) of Philippines is presented in the following aspects: (1) projects being promoted for mangrove forest resource survey and evaluation, coral resource evaluation, coastal resource and environment survey, and other subjects; and (2) activities in accordance with the remote sensing research program of NAMRIA on natural resource condition survey based on the data from LANDSAT satellites, SPOT, Marine Observation Satellites (MOS) and so forth, research of new techniques, procedures to utilize the survey results, and others. Author (NASDA)

N93-21280# Academy of Sciences (USSR), Moscow. Inst. of Radio Engineering and Electronics.

RUSSIAN SPACE SYSTEM FOR THE EARTH REMOTE SENSING [CHIKYUU RIMOTO SENSHINGU NO TAME NO ROSHIA UCHUU KEIKAKU]

Neon A. Armand *In* Science and Technology Agency, Pre Asia Pacific ISY Conference 23 Mar. 1992 p 36-39 In JAPANESE (For primary document see N93-21270 07-43)

Avail: CASI HC A01/MF A01

An overview of the major characteristics of the Russian short-term earth observing systems such as follows is presented: (1) meteorological satellites METEOR-2 and 3, and Geostationary Operational Meteorological Satellite (GOMS); (2) oceanographical satellite OKEAN and OKEAN Satellite Sensor KOSMO-1500; (3) practical land resources satellite RESURS-1, 2, and F; (4) ALAMAZ mission; (5) PRIRODA mission for developing remote sensing technology to assess global changes, to combine visible, infrared, and microwave measurements for simultaneous examination of natural environments of selected regions; and (6) Ecos-A mission.

Author (NASDA)

N93-21281# National Univ. of Singapore. Dept. of Physics.

SUN-SYNCHRONOUS AND GEO-SYNCHRONOUS SATELLITE DATA UTILIZATION FOR ENVIRONMENTAL STUDIES [TAIYOU CHIKYUU DOUKO EISEI DETA NO KANKYOU CHOUSA ENO RIYOU]

Yean-Joo Chong *In* Science and Technology Agency, Pre Asia Pacific ISY Conference 23 Mar. 1992 p 40-41 In JAPANESE (For primary document see N93-21270 07-43)

Avail: CASI HC A01/MF A01

The remote sensing activities in Singapore are presented. Activities explained are as follows: (1) the satellite ground station that are receiving data from the Geostationary Meteorological Satellite-4 (GMS-4), NOAA-11 and 12 satellites on a real-time basis; (2) data processing systems of Singapore University that are being used for resource mapping of the Organism and Coastal Resources project under the Asian-Australia Oceanography Joint Program; and (3) trial have been conducted to utilize the combination of the radiometer data from GMS-4 satellite, the Indian National Satellite System (INSAT), and NOAA satellites with the high-resolution data from the Marine Observation Satellite (MOS), the Infrared Astronomical Satellite (IRAS), ERS, and the Japanese Earth Resources Satellite-1 (JERS-1).

Author (NASDA)

N93-21282# National Research Council, Bangkok (Thailand).

THAILAND ISY ACTIVITIES [TAI KOKU NO KOKUSAI UCHUUNEN KATSUDOU]

Suvit Vibulsresth *In* Science and Technology Agency, Pre Asia Pacific ISY Conference 23 Mar. 1992 p 42-43 In JAPANESE (For primary document see N93-21270 07-43)

Avail: CASI HC A01/MF A01

An overview of the past participation of Thailand in international cooperation in remote sensing activities especially in Association of Southeast Asian Nations (ASEAN) region is presented. An overview of Thailand International Space Year (ISY) activities such as follows is presented: (1) improvement of the ERS-1 ground station; (2) Japan-Thailand remote sensing improvement project to provide satellite data for global change research and tropical forest survey; (3) ASEAN remote sensing cooperation project for promoting joint study and engineer exchange; and (4) ocean environment information project to provide fundamental data on Thailand Bay environment.

Author (NASDA)

N93-21283# Embassy of Australia, Tokyo (Japan).

NATIONAL SPACE PROGRAM IN AUSTRALIA [OSUTORARIA NO UCHUU KEIKAKU]

G. M. Brennan *In* Science and Technology Agency, Pre Asia Pacific ISY Conference 23 Mar. 1992 p 44-48 In JAPANESE (For primary document see N93-21270 07-43)

Avail: CASI HC A01/MF A01

An overview of the Australian space activity history and present status is presented in the following aspects: (1) full-scale space activities since the establishment of the Australian Space Board in 1987 and the start of governmental budgetary support to national space program; (2) cooperation with NASA and ESA through satellite ground stations in satellite communication and ground support; (3) Australian private enterprises contract to provide launch support for INTERSAT and other satellites and schedule to start mobile satellite communication all over the country; and (4) supporting the second ground station construction to facilitate acquisition of the southern Pacific ocean data of the wide area covering from the end of Antarctic continent to the eastern end of New Zealand. The remote sensing equipment development, launch service business plan, present status of supersonic technology in Australia and Australian space policy are outlined.

Author (NASDA)

N93-21284# Embassy of Canada, Tokyo (Japan).

CANADA'S LONGTERM SPACE PLAN AND ISY ACTIVITIES [KANADA NO CHOUKI UCHUU KEIKAKU TO ISY KATSUDOU] **c12**

B. Carl Kuhnke *In* Science and Technology Agency, Pre Asia Pacific ISY Conference 23 Mar. 1992 p 49-52 In JAPANESE (For primary document see N93-21270 07-43)

Avail: CASI HC A01/MF A01

An overview of the space activities conducted by the Canadian Space Agency established in 1989 to implement space-oriented activities by Canadian ministries and agencies is presented in the following aspects: (1) synthetic aperture radar satellite RADARSAT program; (2) space station Freedom program; (3) joining to the ESA (a sole non-European participant); (4) space science (microgravity, fluid physics, combustion, material research and life science) programs including participation in NASDA (National Space Development Agency of Japan) Test Rocket-1A (TR-1A) small rocket project, supply of ion mass spectrometer for Japanese scientific satellite Akebono, ultraviolet aurora imaging equipment for Russian interpole and Swedish flare; and (5) space technology program including the space station, earth mission, and communication. Canadian International Space Year (ISY) activities are outlined.

Author (NASDA)

N93-21285# Embassy of Pakistan, Tokyo (Japan).

PAKISTAN SPACE AND UPPER ATMOSPHERE RESEARCH COMMISSION [PAKISUTAN UCHUU KUUKAN KENKYUU IINKAI (SUPARCO)] **c12**

Mian Suhail Aslam *In* Science and Technology Agency, Pre Asia Pacific ISY Conference 23 Mar. 1992 p 53-55 In JAPANESE (For primary document see N93-21270 07-43)

Avail: CASI HC A01/MF A01

An overview of the major activities conducted by Pakistan Space and Upper Atmosphere Research Commission (SUPARCO) is presented. Subjects of the activities are as follows: (1) atmosphere research; (2) ionosphere and radio wave propagation; (3) remote sensing application; (4) measurement of meteorological, hydrological and oceanographic parameters by ARGOS data collection system; (5) operation of satellite ground station; (6) satellite aided search and rescue project; (7) air pollution monitoring; (8) geomagnetic field observation; (9) Pakistan communication satellite PAKSAT; and (10) international cooperation of SUPARCO with European, American and Asian countries. Major space related facilities, such as the space research council, remote sensing application center, aerospace engineering laboratory, of the SUPARCO are introduced.

Author (NASDA)

N93-21286# National Space Activities Council, Tokyo (Japan).

PANEL DISCUSSION: ROLES OF SPACE PROGRAM IN THE ASIA PACIFIC REGION [PANERU DISUKASSHON: AJIA TAIHEIYOU CHIIKI NI OKERU UCHUU KAIHATSU NO YAKUWARI] **c12**

Tamiya Nomura *In* Science and Technology Agency, Pre Asia Pacific ISY Conference 23 Mar. 1992 p 59-75 In JAPANESE (For primary document see N93-21270 07-43)

Avail: CASI HC A03/MF A01

A panel discussion on the subject 'Roles played by space development in Asia Pacific region' was held chaired by Space Activities Commission member and attended by the representatives of the participating countries, special attendance and observers. Opinions were expressed by each representative on three subjects, that is, social effects and benefits obtained by remote sensing data, observation data desired to augment the effect, and expectation for developed countries in space development. President of NASDA (National Space Development Agency of Japan) expressed his intension to promote international cooperation for the Japanese Earth Resources Satellite-1 (JERS-1) verification program, utilization augmentation of Japanese earth observing satellites and human resource training and education. Deputy Director-General for Science and Technology Agency (STA) outlined ASCA (Association for Science Cooperation in Asia) seminar

and STA fellowship in relation to human resource development. Chairman of the Japan International Space Year (ISY) Association cited the necessity of closer and extensive communication networks free from the existing commercial communication. Deputy-Minister for Posts and Telecommunications outlined the PARTNERS project (Post-operational utilization of the Engineering Test Satellite-5 (ETS-5)) for international cooperation in space activities in Asia Pacific region. President of the Institute of Space and Astronautical Science (ISAS) outlined Japan's present status of and international cooperation in space science. Author (NASDA)

N93-21287# Ministry of Posts and Telecommunications, Tokyo (Japan).
PARTNERS [PARTNERS KEIKAKU: HAN TAIHEIYOU JOUHOU TSUUSHIN NETTO WAKU JIKKEN KEIKAKU] **c84**
Kiyoshi Ooida *In* Science and Technology Agency, Pre Asia Pacific ISY Conference 23 Mar. 1992 p 76-77 In JAPANESE (For primary document see N93-21270 07-43)
Avail: CASI HC A01/MF A01

An overview of the PARTNERS project conducted for the purpose to promote technical cooperation in the area of satellite communication with Asia Pacific countries through joint experiment on subjects including the followings using the Engineering Test Satellite-5 (ETS-5) is presented: (1) validation test for educational and medical utilization; (2) joint research for developing rural satellite network with small mobile ground stations; and (3) joint measurement of radio wave propagation characteristics.
Author (NASDA)

N93-21506# Committee on Appropriations (U.S. House).
REPORT TO CONGRESS ON THE RESTRUCTURING OF THE EARTH OBSERVING SYSTEM
9 Mar. 1992 25 p Sponsored by NASA Prepared in cooperation with Committee on Appropriations (U.S. Senate) Original contains color illustrations reproduced in black and white
(PB93-108587) Avail: CASI HC A03/MF A01

Contents: (1) The Science Objectives of EOS; (2) New Spacecraft Configurations; (3) The Impact of the Restructured EOS on Understanding the Climate; (4) The Impact of EOS on Adaptation and Mitigation Strategies; (5) EOS Data and Information System; (6) Interdisciplinary Investigations; (7) Missions in Advance of EOS; (8) The Role of the Departments of Energy and Defense; (9) Summary of the Mission to Planet Earth; and (10) Funding Requirement. GRA

N93-21539# National Space Development Agency, Tokyo (Japan).
PROCEEDINGS OF THE 14TH EARTH OBSERVATION SYMPOSIUM [DAI 14 KAI CHIKYUU KANSOKU SHINPOJIUMU SHIRYOU]
25 Jul. 1992 80 p In JAPANESE Symposium held in Okinawa, Japan, 25 Jul. 1992 Sponsored by Science and Technology Agency Prepared in cooperation with Japan Federation of Economic Organization, Tokyo; Remote Sensing Technology Center, Tokyo, Japan; and Okinawa Prefectural Office, Japan
(JTN-93-80414) Avail: CASI HC A05/MF A01

The following topics were discussed: trends, satellite observation, satellite sounding, satellite imagery, environmental monitoring, earth resources management, land management, oceanographic parameters, forest management, vegetative index, education and enlightenment about monitoring of earth environment, weather information, visual information, remote sensing for fisheries. For individual titles, see N93-21540 through N93-21546.

N93-21540# Remote Sensing Technology Center, Tokyo (Japan).
PRINCIPLES AND APPLICATION TENDENCY OF REMOTE SENSING: ITS PRINCIPLE, FUNCTION, AND UTILIZATION [RIMOTO SENSHINGU NO GENRI TO RIYOU DOUKOU: GENRI SHIKUMI RIYOU]
Kaname Takeda *In* NASDA, Proceedings of the 14th Earth Observation Symposium 25 Jul. 1992 p 1-15 In JAPANESE (For primary document see N93-21539 07-43)
Avail: CASI HC A03/MF A01

An overview of the fundamental system structure, principles, data collection and distribution, and distribution data formats by related organizations of remote sensing in Japan is presented. Applicability (merit and demerit), geometrical resolution, spectral (wavelength) characteristics (visible and near infrared radiometer, thermal infrared radiometer, microwave radiometer, synthetic aperture radar, and total ozone mapping spectrometer and their suitable application) and time periods between observations of satellite remote sensing are outlined. Remote sensing data application tendency are discussed in the following aspects: (1) utilization from global view points such as world wheat crop prediction, elucidation of El Nino, hydrological survey for desertification prevention, and so on; and (2) utilization from regional view point, especially by local self-governing bodies in such areas as land utilization, forest survey, disaster prevention, environmental survey, and fishery survey. Author (NASDA)

N93-21541# National Space Development Agency, Ohashi (Japan).
PRESENT STATUS AND TENDENCY OF SATELLITE EARTH OBSERVING SYSTEMS [UCHUU KARA NO CHIKYUU KANSOKU SHISUTEMU NO GENJOU OYOBI DOUKOU NI TSUITE]
Nobuyuki Yoshihara *In its* Proceedings of the 14th Earth Observation Symposium 25 Jul. 1992 p 16-18 In JAPANESE (For primary document see N93-21539 07-43)
Avail: CASI HC A01/MF A01

An overview of the following earth observation satellites which data are utilized by the Earth Observation Center (EOC) are presented: (1) LANDSAT; (2) SPOT; (3) Marine Observation Satellite-1b (MOS-1b); (4) Japanese Earth Resources Satellite-1 (JERS-1); and (5) ERS-1 of which the Synthetic Aperture Radar (SAR) data combined with that of JERS-1 is expected to produce new useful information. Remote sensing data received and processed at EOC are cataloged for users' convenience and available to users all over the world through the network operated in international cooperation between Japan (EOC), the US (NASA), and Europe (ESA) as its core. Author (NASDA)

N93-21542# Ryukyu Univ., Okinawa (Japan). Marine Sciences.
STUDY FOR NATURAL ENVIRONMENT IN OKINAWA ISLANDS BY USING REMOTE SENSING [OKINAWA NO SHIZEN KANKYOU TO RIMOTO SENSHINGU]
Momoki Koga *In* NASDA, Proceedings of the 14th Earth Observation Symposium 25 Jul. 1992 p 19-25 In JAPANESE (For primary document see N93-21539 07-43)
Avail: CASI HC A02/MF A01

An overview of the characteristics of the atmospheric and oceanic environments and the island environments in Okinawa, and merits and demerits of the remote sensing technology is presented. Possible areas of remote sensing data utilization such as follows are outlined: (1) weather change (cloud front and typhoon behavior); (2) sea surface temperature and wave distribution; (3) water contamination and coral reef distribution; (4) change of coastal topography and mangrove coverage around river-mouths; (5) subtropical forest distribution and forest activity; and (6) land utilization. Author (NASDA)

N93-21543# Ryukyu Univ., Okinawa (Japan). Environmental Sciences and Technology.
REMOTE SENSING DATA APPLICATION ON FORESTS IN OKINAWA ISLANDS FOCUSING ON MANGROVE FORESTS [OKINAWA NO SHINRIN E NO RIMOTO SENSHINGU NO RIYOU: MANGUROBURIN O CHUUSHIN TO SHITE]
Kazuhiro Satou *In* NASDA, Proceedings of the 14th Earth Observation Symposium 25 Jul. 1992 p 26-33 In JAPANESE (For primary document see N93-21539 07-43)
Avail: CASI HC A02/MF A01

Application of the remote sensing data for use in various aspects of forest survey using Thematic Mapper (TM), Multi-Spectral Scanner (MSS), Return Beam Vidicon (RBV), Side Looking Airborne Radar (SLAR), and Synthetic Aperture Radar (SAR) is described. Characteristics of the forests in Okinawa which is characterized in the dominance of evergreen broadleaf trees and diversity of vegetation are also explained. Examples of the results of the study on mangrove forest classification survey using remote sensing data and on-ground survey are presented. Author (NASDA)

N93-21544# Haebaru Prefecture High School, Okinawa (Japan).
PRODUCTION OF TEACHING MATERIALS FROM GEOSTATIONARY METEOROLOGICAL SATELLITE HIMAWARI IMAGES [KISHOU EISEI 'HIMAWARI' GAZOU NO KYOUZAIKA] **c47**
Isao Touma *In* NASDA, Proceedings of the 14th Earth Observation Symposium 25 Jul. 1992 p 34-45 In JAPANESE (For primary

document see N93-21539 07-43)
Avail: CASI HC A03/MF A01

Teaching materials to get students interested in and concerned about climatic phenomena were produced utilizing Himawari images. Transparencies of dynamic meteorological phenomena images such as low pressure (temperate and tropical), high pressure, typhoon, and so forth were produced. Ten minutes of video image was produced compiling image data acquired from autumn to winter. Transparencies were made photographing various types of clouds paying special attention to the relationship between clouds and topography. Three-dimensional model of temperate low pressure cloud was produced to explain weather phenomena in relation to cloud images. Graphical training plan on structures of typhoons and low pressures was constructed utilizing Himawari images. Guidance plans for the subject of science and geology were constructed utilizing teaching materials cited above. Author (NASDA)

N93-21545# Japan Weather Association, Tokyo. Meteorological Information Center.

CHANGING WEATHER INFORMATION: ROLES OF METEOROLOGICAL INFORMATION THROUGH METEOROLOGICAL SATELLITES [KAWARU TENKI JOUHOU: KISHOU EISEI JOUHOU NO YAKUWARI] c47

Seiichi Saitou *In* NASDA, Proceedings of the 14th Earth Observation Symposium 25 Jul. 1992 p 46-57 In JAPANESE (For primary document see N93-21539 07-43)
Avail: CASI HC A03/MF A01

An overview of application of meteorological satellite information for weather forecasting service and the possibility of utilizing weather information liberalized according to the report of the Meteorological Council are presented. The roles of meteorological satellite information are outlined exemplifying reception of Stretched Visible and Infrared Spin Scan Radiometer (S-VISSR) data four times in resolution as Low-Resolution Fax (LR-FAX) image by Japan Meteorological Association and Television and Infrared Observation Satellite (TIROS) Operational Vertical Sounder (TOVS). Visualization of weather information through combining conventional information such as weather forecast and weather charts, meteorological radar images, Grid Point Values (GPV) issued by the Meteorological Agency is deemed to be important in the future. The following examples of the utilization of satellite information for weather information are outlined: (1) satellite information calendar showing typical atmospheric and oceanic phenomena and satellite information suitable to observe them; (2) future demand for high-level visualization such as three-dimensional display images of typhoons and tinted leave information; and (3) on-line data distribution through image compression. Author (NASDA)

N93-21546# Japan Fisheries Information Service Center, Tokyo. Development Section.

FINDING FISH WAY BY USING REMOTE SENSING [RIMOTO SENSHINGU NI YORI GYODOU OMITSUKERU]

Hideo Tameishi *In* NASDA, Proceedings of the 14th Earth Observation Symposium 25 Jul. 1992 p 58-77 In JAPANESE (For primary document see N93-21539 07-43)
Avail: CASI HC A03/MF A01

Fishing ground formation factors and environmental factors for schools of fish off Sanriku coast are examined by plotting fishery condition data on sea state data such as NOAA satellite thermal infrared images, coastal sea state maps drawn by analyzing satellite data, NIMBUS-7 satellite Coastal Zone Color Scanner (CZCS), airplane survey flight data, and so forth correlation between schools of sardine and warm streamers originated from a warm water vortex verified by applying airplane fish-finder survey. Combining sea water color data obtained from airplane water color measurement and NIMBUS-7 satellite CZCS data with the above results, surroundings of warm streamers extending into the Oyashio current is where the food chain is apt to occurs markedly. Author (NASDA)

N93-21560# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

THE DISTRIBUTION OF GREEN AREAS IN URBAN AREAS: CARTOGRAPHY AND COMPARATIVE ANALYSIS OF LANDSAT TM AND HRV/SPOT DATA [A DISTRIBUICAO DOS ESPACOS VERDES EM AREAS URBANAS: CARTOGRAFIA E ANALISE COMPARATIVE ENTRE DADOS TM/LANDSAT E HRV/SPOT]

Ana Lucia Ramos Carrara, Celina Foresti, and Joao Roberto dosSantos Apr. 1991 15 p In PORTUGESE
(INPE-5262-PRE/1686) Avail: CASI HC A03/MF A01

The intense urbanization process that took place during the last decades in Brazil has strongly reduced the vegetation component, thus affecting the quality of life in these urban areas. Currently, the qualitative and quantitative mapping of vegetation within urban areas is the basis of planning to improve the quality of the urban environment. The objective is to show the usefulness of orbital sensors data to map the 'green areas' within cities. Numerical models known as 'vegetation index', obtained from TM-LANDSAT (30 m spatial resolution) and HRV-SPOT (20 m spatial resolution), were employed to obtain a map showing the distribution of the urban vegetation. A comparative analysis between the classifications from the two data sets is performed taking into account the minor differences of spectral and spatial resolutions between them. The final product presented is a qualitative and quantitative description of the 'vegetation index' classes associated with urban land use classes. Author

N93-21648# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

RATE OF HEATING OF THE FOREST INTERIOR [TAUX DE RECHAUFFEMENT A L'INTERIEUR DE LA FORET]

Ruberio Prado Britto Apr. 1991 15 p In PORTUGESE
(INPE-5235-RPQ/647) Avail: CASI HC A03/MF A01

Measurements and estimation of the rate of mean differential heating in a layer of 35 meters close to the soil and inside the Landes forest is presented and discussed. The rate of mean differential heating is presented for each level in the profile (1-35 m), similar variation leads to the conclusion that the heating of the forest is made up on a global way. The quotient d(theta)/dt reaches its maximum value of 3 C/h at 9 a.m. and a minimum of -3 C/h at 5 p.m. This method presents satisfactory results and at the same time introduces the estimation of time lags in the profile levels. The main difficulty in the application of the method is due to the canopy interception. Author (revised)

N93-21657# National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.

SPECIALIST MEETING ON MICROWAVE RADIOMETRY AND REMOTE SENSING APPLICATIONS, MURAD 92

Ed R. Westwater, ed. Jun. 1992 493 p Meeting held in Boulder, CO, 14-16 Jan. 1992
(PB93-105757) Avail: CASI HC A21/MF A04

Contents: Session 1--Satellite/Atmosphere; Session 2--Land and Soil Moisture; Session 3: Sea Surface and Snow; Session 4--Planets; Session 5--New Technology; Session 6--Theory; Session 7--DMSP; Session 8--Ground-Based; Session 9--Airborne. GRA

N93-21685# Forest Service, New Orleans, LA. Southern Forest Experiment Station.

ADVANCED VERY HIGH RESOLUTION RADIOMETER DATA TO UPDATE FOREST AREA CHANGE FOR MIDSOUTH STATES Research Paper

Zhiliang Zhu Aug. 1992 16 p
(PB93-121416; FSRP-SO-270) Avail: CASI HC A03/MF A01

Advanced Very High Resolution Radiometer (AVHRR) data were used to determine forest area and detect change in Alabama. Level-1 supervised classifications were performed in six survey units using single-date (1982 and 1990) and multidate (1991) AVHRR data. Forest area statistics derived from the AVHRR classifications compared well with Southern Forest Experiment Station Forest Inventory and Analysis (SO-FAI) survey estimates at the county, survey unit, and State levels. Changes in forest area were determined by comparing 1982 and 1990 AVHRR classifications. Use of multi-date AVHRR data and data stratification based on physiographic survey units were shown to significantly improve forest area classification. GRA

N93-21698*# Alabama Univ., Huntsville. Dept. of Physics.

RADIATIVE TRANSFER MODELS Final Report, Oct. 1990 - Oct. 1992

James L. Horwitz 28 Oct. 1992 36 p
(Contract NAS8-36955)
(NASA-CR-192433; NAS 1.26:192433) Avail: CASI HC A03/MF A01

The purpose of this work was to assist with the development of analytical techniques for the interpretation of infrared observations. We

have done the following: (1) helped to develop models for continuum absorption calculations for water vapor in the far infrared spectral region; (2) worked on models for pressure-induced absorption for O2 and N2 and their comparison with available observations; and (3) developed preliminary studies of non-local thermal equilibrium effects in the upper stratosphere and mesosphere for infrared gases. These new techniques were employed for analysis of balloon-borne far infrared data by a group at the Harvard-Smithsonian Center for Astrophysics. The empirical continuum absorption model for water vapor in the far infrared spectral region and the pressure-induced N2 absorption model were found to give satisfactory results in the retrieval of the mixing ratios of a number of stratospheric trace constituents from balloon-borne far infrared observations.

Derived from text

N93-21754# Orincon Corp., Arlington, VA.
REMOTE SENSING: ENVIRONMENTAL EFFECTS OF SURFACE FILMS
Final Report
15 Dec. 1992 91 p
(Contract N00014-81-C-0476)
(AD-A258571; OCR-92-U-0488) Avail: CASI HC A05/MF A01

This report describes a portion of a program involving both experimental and theoretical studies of the influences of natural biogenic sea surface films on air-sea interfacial parameters. In addition, the role of physical processes in the marine environment on the film's state and transport was investigated. Initial objectives included the determination of the effects of (1) currents on film formation and intensity, (2) surface films on waves, (3) surface films on wave/current interactions, and (4) surface films on near-surface turbulence. During the planning phase of the program these objectives were refined to emphasize the following specific subject areas: (1) film transport and modulation by currents; (2) surface-film influences on capillary waves for surface film concentrations and strain rates appropriate to surface effects of ocean internal waves; and (3) determination of the effect of surface films on the wind-wave relaxation rate beta by direct measurement at wavelengths of interest to microwave radar imaging.

GRA

N93-20172*# Nebraska Univ., Lincoln. Dept. of Electrical Engineering and Center for Communication and Information Science.
DATA COMPRESSION IN REMOTE SENSING APPLICATIONS
Khalid Sayood *In its* Study and Simulation of Low Rate Video Coding Schemes 15 Dec. 1992 9 p (For primary document see N93-20170 07-32)
(Grants NAG3-806; NAG5-1612)
Avail: CASI HC A02/MF A02

N93-20173*# Nebraska Univ., Omaha. Medical Center.
COMPRESSION OF COLOR-MAPPED IMAGES
A. C. Hadenfeldt and Khalid Sayood (Nebraska Univ., Lincoln.) *In* Nebraska Univ., Study and Simulation of Low Rate Video Coding Schemes 15 Dec. 1992 17 p (For primary document see N93-20170 07-32)
(Grants NAG3-806; NAG5-1612)
Avail: CASI HC A03/MF A02

N93-21571# Freie Univ., Berlin (Germany). Inst. fuer Meteorologie.
END-TO-END TESTS OF SATELLITE DATA
H. Billing, H.-J. Bolle, and M. Eckardt *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 9-12 (For primary document see N93-21569 07-42)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-21574# Freie Univ., Berlin (Germany). Inst. fuer Meteorologie.
THE 8 YEARS MONTHLY VEGETATION INDEX OF CENTRAL EUROPE
D. Koslowsky, H.-J. Bolle, U. Katergiannakis, D. Praetorius, and W. Tonn *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 25-30 (For primary document see N93-21569 07-42)
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-21575# Ecole Nationale Superieure de Physique, Strasbourg (France).
EVALUATION OF THE INTERNATIONAL DIRECTORY NETWORK FOR LOCATION OF DATA SETS USEFUL IN GLOBAL VEGETATION CHANGE ASSESSMENT
R. Thomas and C. Weber (Centre National de la Recherche Scientifique, Strasbourg, France.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 31-36 Sponsored by Univ. Louis Pasteur, CNRS, and International Space Univ. (For primary document see N93-21569 07-42)
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-21576# Canada Centre for Remote Sensing, Ottawa (Ontario).
INFLUENCE OF TERRAIN ELEVATION ON VEGETATION INDICES DERIVED FROM NOAA AVHRR AND EOS MODIS DATA
P. M. Teillet, K. Staenz, and J.-F. Parent *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 37-42 (For primary document see N93-21569 07-42)
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-21577# GKSS-Forschungszentrum Geesthacht (Germany).
ESTIMATING CHLOROPHYLL CONCENTRATIONS FROM THEMATIC MAPPER DATA
Carsten Brockmann *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 43-48 (For primary document see N93-21569 07-42)
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-21581# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Berlin (Germany). Space Sensor Technology Inst.
CAN MEASUREMENTS IN THE O2A- AND B-BANDS BE USED FOR ATMOSPHERIC CORRECTION OF SATELLITE MEASUREMENTS OVER THE OCEAN?
B. Pflug, B. Piesik, and G. Zimmermann *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 65-68 (For primary document see N93-21569 07-42)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-21582# Centre de Meteorologie Spatiale, Lannion (France).
VEGETATION COVER MAPPING OVER FRANCE USING NOAA-11/AVHRR
M. Derrien, B. Farki, H. LeGleau, and A. Sairouni *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 69-73 (For primary document see N93-21569 07-42)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-21583# Technical Research Centre of Finland, Espoo. Remote Sensing Section.
ESTIMATION OF CARBON STORAGE AND ORGANIC MATTER IN BOREAL FORESTS USING OPTICAL REMOTE SENSING DATA
T. Haeme, A. Salli, and K. Lahti *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 75-78 (For primary document see N93-21569 07-42)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-21584# Mullard Space Science Lab., Dorking (England).
MONITORING WETLAND HYDROLOGY BY REMOTE SENSING: A CASE STUDY OF THE SUDD USING INFRA-RED IMAGERY AND RADAR ALTIMETRY
I. M. Mason, A. R. Harris, J. N. Moody, C. M. Birkett, W. Cudlip, and D. Vlachogiannis *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 79-84 (For primary document see N93-21569 07-42)
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N93-21585# Lund Univ. (Sweden). Dept. of Physical Geography.
DEFORESTATION IN AFRICAN DRY LANDS: ASSESSMENT OF CHANGES IN WOODY VEGETATION IN SEMI ARID SUDAN
Lennart Olsson and Jonas Ardoe *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 85-89 (For primary document see N93-21569 07-42)
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N93-21586# Meteorological Office, Bracknell (England). Hadley Centre for Climate Prediction and Research.
SIMULATION OF CLEAR-SKY OUTGOING LONGWAVE RADIATION OVER THE OCEANS USING OPERATIONAL ANALYSES
A. Slingo and M. J. Webb *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 93-98 (For primary document see N93-21569 07-42)
(Contract PECD-7/12/37)
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-21603# Hamburg Univ. (Germany). Meteorologisches Inst.
REMOTE SENSING OF LATENT HEAT FLUXES AT THE AIR-SEA INTERFACE
Joerg Schulz and Peter Schluessel *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 179-183 (For primary document see N93-21569 07-42)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-21604# Ecole Nationale Superieure des Mines, Sophia-Antipolis (France). Centre d'Energetique.
AIR/SEA LATENT HEAT FLUX MEASUREMENTS WITH MICROWAVE RADIOMETERS
F. Cauneau and R. Bernard (Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux, France.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 185-188 Sponsored by Centre National d'Etudes des Telecommunications, CNRS, and Inst. National des Sciences de l'Univers (For primary document see N93-21569 07-42)
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N93-21606# Mullard Space Science Lab., Dorking (England).
ERS-1 RADAR ALTIMETRY OF ICE SHEETS Abstract Only
C. G. Rapley, J. Morley, and S. Laxon *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 197 (For primary document see N93-21569 07-42)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-21609# European Centre for Medium-Range Weather Forecasts, Reading (England).
THE WAM MODEL AND ERS-1
H. Guenther (GKSS-Forschungszentrum Geesthacht, Germany.) and B. Hansen *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 217-221 (For primary document see N93-21569 07-42)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-21612# Centre de Meteorologie Spatiale, Lannion (France).
TRANSMITTANCE COEFFICIENTS GENERATION FOR FAST RADIATIVE TRANSFER MODELS: APPLICATION TO NEW SATELLITE SOUNDING SYSTEMS
P. Brunel, L. Lavanant, and G. Rochard *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 229-233 (For primary document see N93-21569 07-42)
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N93-21618# Technische Univ., Munich (Germany). Meteorologisches Inst.
SAMPLING PROPERTIES OF A SPACEBORNE LIDAR (ATLID)
Joerg Ackermann, Matthias Wiegner, and Heinrich Quenzel *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 261-265 (For primary document see N93-21569 07-42)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-21625# Hungarian Meteorological Society, Budapest. Satellite Research Lab.
DETERMINATION OF LONGWAVE RADIATION REACHING THE SURFACE FROM METEOSAT IMAGES AND RADIATION MODEL CALCULATIONS
A. Rimoczi-Paal *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 301-304 (For primary document see N93-21569 07-42)
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N93-21631# Joint Research Centre of the European Communities, Ispra (Italy). Safety Technology Inst.
MODELLING THE SKIN-BULK TEMPERATURE DIFFERENCE NEAR THE SEA-ATMOSPHERE INTERFACE FOR REMOTE SENSING APPLICATIONS
W. Eifler *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 335-340 (For primary document see N93-21569 07-42)
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N93-21632*# Hamburg Univ. (Germany). Meteorologisches Inst.
A COMPREHENSIVE COMPARISON BETWEEN SKIN AND MULTI-CHANNEL SEA SURFACE TEMPERATURES AS DERIVED FROM AVHRR
Peter Schluessel, Gary A. Wick (Colorado Univ., Boulder.), and William J. Emery (Colorado Univ., Boulder.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 341-346 Sponsored by NASA and DFG (For primary document see N93-21569 07-42)
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-21635# Lund Univ. (Sweden). Dept. of Water Resources Engineering.
A STUDY OF THE THERMAL BAR IN LAKE LADOGA (RUSSIA) USING NOAA-AVHRR DATA
Lennart Joensson and Joakim Malm *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 361-365 Sponsored by Swedish Natural Science Research Council, Lisshed's Foundation, and Royal Swedish Academy of Sciences (For primary document see N93-21569 07-42)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-21636# Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Atmospheric Research Div.
INTERCOMPARISON OF SATELLITE-DERIVED SEA SURFACE TEMPERATURES
I. J. Barton, A. M. Zavody (Rutherford High Energy Lab., Chilton, England.), A. J. Prata, D. T. Llewellyn-Jones (Rutherford High Energy Lab., Chilton, England.), P. Bailey (Rutherford High Energy Lab., Chilton, England.), R. P. Cechet, M. R. Gorman (Rutherford High Energy Lab., Chilton, England.), P. Kent (Rutherford High Energy Lab., Chilton, England.), D. J. Lee (Rutherford High Energy Lab., Chilton, England.), and C. T. Mutlow et al *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 367-372 (For primary document see N93-21569 07-42)
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-21637# Commonwealth Scientific and Industrial Research Organization, Mordialoc (Australia). Atmospheric Research Div.
GENERATION AND DISTRIBUTION OF REMOTELY-SENSED SEA SURFACE TEMPERATURE IMAGES
A. C. Dilley, C. C. Elsum, M. Edwards, and I. J. Barton *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 373-375 (For primary document see N93-21569 07-42)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-21638# Hamburg Univ. (Germany). Inst. fuer Meereskunde.
SATELLITE DATA ASSIMILATION IN THE WAVE MODEL 3G-WAM
E. Bauer, K. Hasselmann (Max-Planck-Inst. fuer Meteorologie, Hamburg, Germany.), and I. R. Young (New South Wales Univ., Campbell, Australia.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 377-380 (For primary document see N93-21569 07-42)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-21639# Hamburg Univ. (Germany). Inst. fuer Meereskunde.
GLOBAL VALIDATION OF THE WAVE MODEL WAM USING GEOSAT WAVE HEIGHT DATA
Roland Romeiser *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 381-385 (For primary document see N93-21569 07-42)
(Grants BMFT-07-KF-2121; BMFT-01-QS-90160)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-21640# Alenia Spazio S.p.A., Rome (Italy).
SPACE RADAR ALTIMETRY DEVELOPMENT FROM OCEAN MONITORING TO LAND TOPOGRAPHY
G. Levrini, F. S. Rubertone, and R. Somma *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 387-392 (For primary document see N93-21569 07-42)
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N93-20261*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
FLUX CONCENTRATIONS ON SOLAR DYNAMIC COMPONENTS DUE TO MISPOINTING
Daniel S. Rylicki Nov. 1992 21 p Original contains color illustrations
(RTOP 474-12-10)
(NASA-TM-105756; E-7168; NAS 1.15:105756) Avail: CASI HC A03/MF A01; 8 functional color pages

Mispointing of the solar dynamic (SD) concentrator designed for use on Space Station Freedom (SSF) causes the optical axis of the concentrator to be nonparallel to the incoming rays from the Sun. This causes solar flux not to be focused into the aperture hole of the receiver and may position the flux on other SSF components. A Rocketdyne analysis has determined the thermal impact of off-axis radiation due to mispointing on elements of the SD module and photovoltaic (PV) arrays. The conclusion was that flux distributions on some of the radiator components, the two-axis gimbal rings, the truss, and the PV arrays could present problems. The OFFSET computer code was used at Lewis Research Center to further investigate these flux distributions incident on components. The Lewis study included distributions for a greater range of mispoint angles than the Rocketdyne study. Author

N93-20301 Massachusetts Univ., Lowell.
CONVERSION EFFICIENCY IN SOLAR THERMAL SYSTEMS Ph.D. Thesis
Efstratios Nicholas Soubassakis 1992 186 p
Avail: Univ. Microfilms Order No. DA9234489

The viability of solar thermal power systems depends on how effectively they convert sunlight into a useful form of energy. Relative to many human needs, the solar power reaching the earth per unit area is small. Large collector surfaces are needed; in addition, for many utilization schemes, it is desirable to increase the intensity of the radiant flux incident on active absorbers by using concentrators. When the collected sunlight is reflected or refracted onto an absorber surface which is smaller than the collector surface, radiative and convective losses are lowered and the system has the potential to produce more work. This potential depends on the ability of the designer to lower the resistance to heat transfer between the absorbing surface and the working fluid. Low thermal resistance may be even more important for high temperature applications: those applications may be simply not feasible if the resistance is not low enough. This thesis discusses the thermal performance of several systems, and the dependence of this performance on concentration, thermal resistance, and coolant flow rates. Various realistic solar plant configurations have been evaluated, where different optical systems reflect light upon absorbers cooled by a variety of means. Results are obtained in terms of the operating temperatures at which collected solar energy can be most efficiently converted to work. The dependence of the optimum operating temperature on the resistance to thermal heat transfer between the surface temperature and the working fluid at a given concentration is also analyzed. The improvements in the overall system performance achieved using enhanced heat removal schemes by nonconventional means (direct absorption in solid particles or liquids, heat pipes, etc.) from the absorber surface are shown to be necessary for the attainment of very high temperatures. A self-consistent thermodynamic and heat-transfer treatment is used as the tool in the identification of systems which may work, and in the elimination of systems which will not work because of thermal or materials limitations. Dissert. Abstr.

N93-20490*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

THE 1992 NASA AEROSPACE BATTERY WORKSHOP

Jeffrey C. Brewer, comp. Washington Feb. 1993 751 p Workshop held in Huntsville, AL, 15-19 Nov. 1992

(NASA-CP-3192; M-712; NAS 1.55:3192) Avail: CASI HC A99/MF A06

This document contains the proceedings of the 23rd annual NASA Aerospace Battery Workshop, hosted by the Marshall Space Flight Center on November 15-19, 1992. The workshop was attended by scientists and engineers from various agencies of the U.S. Government, aerospace contractors, and battery manufacturers, as well as international participation in like kind from a number of countries around the world. The subjects covered included nickel-cadmium, nickel-hydrogen, nickel-metal hydride, and lithium based technologies, as well as advanced technologies including sodium-sulfur and various bipolar designs. For individual titles, see N93-20491 through N93-20527.

N93-20491*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

NASA CENTER UPDATE: GODDARD SPACE FLIGHT CENTER

Gopalakrishna M. Rao *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 3-32 (For primary document see N93-20490 07-44)

Avail: CASI HC A03/MF A06

The topics covered are presented in viewgraph form and include the following: spacecraft operations, life cycle testing an the Naval Surface Warfare Center (NSWC), and destructive physical analysis at COMSAT laboratories. The subtopics under spacecraft operations are the Solar Anomalous and Magnetospheric Particle Explorer (SAMPEX), the Extreme Ultraviolet Explorer (EUVE), the Upper Atmospheric Research Satellite (UARS), the Compton Gamma Ray Observatory (GRO), the Earth Radiation Budget Satellite (ERBS), and the Hubble Space Telescope (HST). The subtopics under the life cycle testing at NSWC are the following: advanced NiCd cells from Hughes Aircraft Company/Eagle Picher Industries; conventional NiCd cells from Gates Aerospace Batteries; conventional NiCd cells from General Electric; NiCd cells from SAFT; NiH2 celss from Eagle Picher Industries; and data as of 10/26/92. CASI

N93-20492*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

NASA CENTER UPDATE: JET PROPULSION LABORATORY

Sal DiStefano *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 33-51 (For primary document see N93-20490 07-44)

Avail: CASI HC A03/MF A06

The topics covered are presented in viewgraph form and include the following: flight project support activities for TOPEX and the Mars Observer; and research/development and engineering activities for NiCd model development, secondary lithium battery development, the sodium-NiCl2 moderate temperature battery, Li-SOCl2 batteries for the Centaur launch vehicle, and direct hydrocarbon/methanol fuel cells. CASI

N93-20493*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

LEWIS RESEARCH CENTER BATTERY OVERVIEW

Patricia ODonnell *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 53-85 (For primary document see N93-20490 07-44)

Avail: CASI HC A03/MF A06

The topics covered are presented in viewgraph form and include the following: the Advanced Communications Technology Satellite; the Space Station Freedom (SSF) photovoltaic power module division; Ni/H2 battery and cell design; individual pressure vessel (IPV) nickel-hydrogen cell testing SSF support; the LeRC Electrochemical Technology Branch; improved design IPV nickel-hydrogen cells; advanced technology for IPV nickel-hydrogen flight cells; a lightweight nickel-hydrogen cell; bipolar nickel-hydrogen battery development and technology; aerospace nickel-metal hydride cells; the NASA Sodium-Sulfur Cell Technology Flight Experiment; and the lithium-carbon dioxide battery thermodynamic model. CASI

N93-20494*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

MARSHALL SPACE FLIGHT CENTER BATTERY ACTIVITY

Eric Lowery *In its* The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 87-109 (For primary document see N93-20490 07-44)

Avail: CASI HC A03/MF A06

The topics covered are presented in viewgraph form and include a flight program history and in-house activities. Some of the in-house activities addressed include secondary battery/cell testing and Hubble Space Telescope Test data updates involving the NiCd type 40 test - battery 1 and 2, the NiCd type 41 test battery, the general electric battery, the NiCd six-battery system, the six four-cell packs, fourteen-cell pack, three four-cell packs, the NiH2 six-battery system, and the flight spare battery. A general test data update is also presented for the twelve-cell pack, the four four-cell packs, the reconditioning test, and planned Ni-MH testing. CASI

N93-20495*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

COMSAT'S DESTRUCTIVE PHYSICAL ANALYSIS OF AEROSPACE NICKEL-CADMIUM CELLS FOR NASA/GODDARD SPACE FLIGHT CENTER

Kathleen M. B. Robbins (Communications Satellite Corp., Clarksburg, MD.), Gopalakrishna M. Rao, and Thomas Y. Yi *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 123-14 (For primary document see N93-20490 07-44)

Avail: CASI HC A03/MF A06

Over the past 5 years, COMSAT has performed numerous destructive physical analyses (DPA's) on NASA-Goddard-supplied nickel-cadmium (Ni/Cd) cells. The samples included activated but uncycled cells, wet stored cells, cycled cells, and anomalous cells. The DPA's provided visual, morphological, and chemical analyses of the cell components. The DPA data for the analyzed cells are presented. For the cells investigated, the leading cause of poor performance, as determined by DPA, has been poor negative electrode utilization, which resulted in negative-electrode-limiting operation. Author

N93-20496*# Aerospace Corp., El Segundo, CA. Electronics Technology Center.

MECHANISMS FOR CAPACITY FADING IN THE NIH2 CELL AND ITS EFFECTS ON CYCLE LIFE

Albert H. Zimmerman *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 153-17 (For primary document see N93-20490 07-44)

Avail: CASI HC A03/MF A06

During recent years there have been a number of instances where the capacity of nickel hydrogen battery cells has proven to be unstable during storage. The capacity losses seen after periods of cell or battery storage have typically varied from only a small amount of fading, up to about 30 percent of the total cell capacity. Detailed studies into the root causes for such fading have been carried out in a number of instances. This report provides an overview of the different mechanisms that have been found to be responsible for such capacity fading in nickel hydrogen cells, and summarizes the presently available data on how each responsible mechanism affects ultimate cell cycle life. Derived from text

N93-20497*# Hughes Aircraft Co., Torrance, CA.

MIGRATION OF Co IN NICKEL OXIDE/HYDROXIDE OF A NICKEL ELECTRODE IN A Ni/H2 CELL

Hong S. Lim and Robert E. Doty *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 177-19 (For primary document see N93-20490 07-44)

Avail: CASI HC A03/MF A06

Cobalt redistribution in nickel active material has been reported. This redistribution was suspected to be related to capacity fading. The objective of this work is to establish a relationship between cobalt redistribution and capacity fading. Microscopic cobalt distribution in nickel active material was studied using three EDX techniques: line scan, point-by-point analysis, and dot maps. Results from this study are presented. Derived from text

N93-20498*# Societe des Accumulateurs Fixes et de Traction, Romainville (France). Space Dept.

NICKEL HYDROGEN CAPACITY LOSS

Jacques Goualard, D. Paugam, and Y. Borthomieu *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb.

1993 p 199-20 (For primary document see N93-20490 07-44)
Avail: CASI HC A03/MF A06

The results of tests to assess capacity loss in nickel hydrogen cells are presented in outline form. The effects of long storage (greater than 1 month), high hydrogen pressure storage, high cobalt content, and recovery actions are addressed. CASI

N93-20499*# Eagle-Picher Industries, Inc., Colorado Springs, CO.
CAPACITY FADE IN NICKEL CADMIUM AND NICKEL HYDROGEN CELLS
Tim Edgar, Jeff Hayden, David F. Pickett (Hughes Aircraft Co., Torrance, CA.), Bruce Abrams-Blakemore, and Ed Liptak *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 211-23 (For primary document see N93-20490 07-44)
Avail: CASI HC A03/MF A06

Research and operational experience with capacity fade in nickel cadmium and nickel hydrogen cells are summarized in outline form. The theoretical causes of capacity fade are reviewed and the role of cell storage, positive electrodes, and cobalt additives are addressed. Three examples of observed capacity fade are discussed: INTELSAT 5, INTELSAT 6, and an Explorer platform. Finally, prevention and recovery methods are addressed and the current status of Eagle Picher/Hughes research is discussed. CASI

N93-20500*# Johnson Controls, Inc., Milwaukee, WI. Nickel Hydrogen Battery Div.
NiH2 CAPACITY FADE DURING EARLY CYCLING
Jeffrey P. Zagrodnik *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 235-24 (For primary document see N93-20490 07-44)
Avail: CASI HC A03/MF A06

Tests were conducted on nickel hydrogen batteries to determine the charge efficiency of the nickel electrode as a function of rate and temperature, cell discharge capacity, and capacity fade. Test procedures and results are presented in outline and graphic form. CASI

N93-20501*# Communications Satellite Corp., Clarksburg, MD.
CHARACTERISTICS OF STORAGE RELATED CAPACITY LOSS IN Ni/H2 CELLS
Hari Vaidyanathan *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 247-26 (For primary document see N93-20490 07-44)
(STD/92-118) Avail: CASI HC A03/MF A06

The changes in the capacity, voltage and pressure profile of flight configuration Ni/H2 cells when they are stored for extended periods is examined. The Ni/H2 cells exhibit capacity fade phenomenon regardless of their design when they are stored at room temperature. Capacity loss also occurs if old cells (5 years old) are stored in a very low rate trickle charge (C/200 rate) condition. A periodic recharge technique leads to pressure rise in the cells. Conventional trickle charge (C/100 rate) helps in minimizing or eliminating the second plateau which is one of the characteristics of the capacity fade phenomenon. Author (revised)

N93-20502*# Eagle-Picher Industries, Inc., Joplin, MO.
NICKEL HYDROGEN BATTERY CELL STORAGE MATRIX TEST
James R. Wheeler and Gary W. Dodson *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 267-27 (For primary document see N93-20490 07-44)
Avail: CASI HC A02/MF A06

Test were conducted to evaluate post storage performance of nickel hydrogen cells with various design variables, the most significant being nickel precharge versus hydrogen precharge. Test procedures and results are presented in outline and graphic form. CASI

N93-20503*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
CAPACITY RECOVERY AFTER STORAGE NEGATIVELY PRECHARGED NICKEL HYDROGEN CELLS
John E. Lowery *In its* The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 277-288 (For primary document see N93-20490 07-44)
Avail: CASI HC A03/MF A06

Tests were conducted to investigate the recovery of capacity lost during open circuit storage of negatively precharged nickel hydrogen batteries. Four Eagle Picher RNH-90-3 cells were used in the tests. Recovery procedures and test results are presented in outline and graphic form. CASI

N93-20504*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
CHARGE RETENTION TEST EXPERIENCES ON HUBBLE SPACE TELESCOPE NICKEL-HYDROGEN BATTERY CELLS
Dave E. Nawrocki (Lockheed Missiles and Space Co., Sunnyvale, CA.), J. R. Driscoll (Lockheed Missiles and Space Co., Sunnyvale, CA.), J. D. Armantrout (Lockheed Missiles and Space Co., Sunnyvale, CA.), R. C. Baker (Eagle-Picher Industries, Inc., Colorado Springs, CO.), and H. Wajsgras *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 293-31 (For primary document see N93-20490 07-44)
Avail: CASI HC A03/MF A06

The Hubble Space Telescope (HST) nickel-hydrogen battery module was designed by Lockheed Missile & Space Co (LMSC) and manufactured by Eagle-Picher Ind. (EPI) for the Marshall Space Flight Center (MSFC) as an Orbital Replacement Unit (ORU) for the nickel-cadmium batteries originally selected for this low earth orbit mission. The design features of the HST nickel hydrogen battery are described and the results of an extended charge retention test are summarized. Derived from text

N93-20505*# Naval Surface Warfare Center, Crane, IN.
AIR FORCE Ni-Cd CELL QUALIFICATION PROGRAM UPDATE
Steve Hall, Harry Brown, G. Collins (Aerospace Corp., El Segundo, CA.), W. Hwang (Aerospace Corp., El Segundo, CA.), and Q. Bui (Air Force Systems Command, Norton AFB, CA.) *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 319-35 (For primary document see N93-20490 07-44)
Avail: CASI HC A03/MF A06

The generic qualification of aerospace nickel-cadmium cells is discussed. The test program includes the following: all available manufacturers, all available designs, cells from the previous program, and high and low orbit life cycling. It is the purpose of this program to characterize the beginning of life performance. CASI

N93-20506*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ELECTRICAL CHARACTERIZATION OF THE MAGELLAN BATTERIES AFTER STORAGE
Frank Deligiannis, D. Perrone, Sal DiStefano, and Paul Timmerman *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 355-36 (For primary document see N93-20490 07-44)
Avail: CASI HC A02/MF A06

Two 22 cell batteries designed by Martin Marietta were tested. The batteries were rated at 26.5 Amp-Hr. The battery design is characterized by the following: Gates Aerospace 42B030AB15, 11 pos/12 neg, Pellon 2536 separator, passivated pos/teflonated neg. The tests can be summarized as follows: (1) no noticeable capacity loss after storage period; and (2) batteries exhibited larger non-uniformity of cell voltages during constant current charge. CASI

N93-20507*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
TOPEX/POSEIDON BATTERY PERFORMANCE
Frank Deligiannis, Sal DiStefano, and Gerald Halpert *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 363-38 (For primary document see N93-20490 07-44)
Avail: CASI HC A03/MF A06

The following observations were made during the first occultation period: (1) C/D ratios tend to be higher during the initial and final segment of the occultation period; (2) the net overcharge parameter is useful in assessing C/D's; (3) small peak power cusps were present during the initial and final segment of the occultation period--no cusps during the remaining period; (4) small differential voltages (less than 12 mV) were recorded; and (5) the peak charge current was within the recommended limits. In summary, the batteries are operating within recommended limits, and their performance is excellent. CASI

N93-20508*# McDonnell-Douglas Electronics Co., Saint Charles, MO. Space Electronics.

PRELIMINARY RESULTS: ROOT CAUSE INVESTIGATION OF ORBITAL ANOMALIES AND FAILURES IN NASA STANDARD 50 AMPERE-HOUR NICKEL-CADMIUM BATTERIES

Mark R. Toft *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 383-41 (For primary document see N93-20490 07-44)

Avail: CASI HC A03/MF A06

Two lots of NASA standard 50 A.H. Ni-Cd battery cells, manufactured by Gates Aerospace Batteries and built into batteries by McDonnell Douglas, have experienced significant performance problems. The two lots were used on the Compton Gamma Ray Observatory and the Upper Atmosphere Research Satellite. Both of these satellites are Low Earth Orbital (LEO) satellites containing batteries on a parallel bus charged to NASA standard V/T curves using a NASA standard power regulator. The following preliminary conclusions were reached: (1) several plate and cell parameters have migrated within their spec limits over the years (in some cases, from one extreme to the other); (2) several parametric relationships, not generally monitored and therefore not under specification control, have also migrated over the years; (3) many of these changes appear to have taken place as a natural consequence of changes in GE/GAB materials and processes; (4) several of these factors may be 'conspiring' to aggravate known cell failure mechanisms (factors such as heavier plate, less teflon and/or less-uniform teflon, and less electrolyte) but all are still in spec (where specs exist); (5) the weight of the evidence collected to characterize the anomalies and to characterize the negative electrode itself, strongly suggests that alterations to the structure, composition, uniformity, and efficiency of the negative electrode are at the heart of the battery performance problems currently being experienced; and (6) further investigation at all levels (plate, cell, battery, and system) continues to be warranted. Derived from text

N93-20509*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

THE JPL/NASA/TAMU NICKEL-CADMIUM BATTERY MODEL DEVELOPMENT STATUS

Paul Timmerman *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 419-43 (For primary document see N93-20490 07-44)

Avail: CASI HC A03/MF A06

A discussion of the development of a fundamental cell model is presented in vugraph format. The nickel oxide layer is described in terms of the electronic conductivity of the oxide layer and proton diffusion through the oxide layer. The kinetic and conductivity expressions for the cadmium electrode were improved. The development process yielded performance predictions that are significantly improved. CASI

N93-20510*# Reliability Analysis Center, Rome, NY.

NiCd CELL RELIABILITY IN THE MISSION ENVIRONMENT

William K. Denson and Glenn C. Klein (Gates Aerospace Batteries, Gainesville, FL.) *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 437-45 (For primary document see N93-20490 07-44)

Avail: CASI HC A03/MF A06

This paper summarizes an effort by Gates Aerospace Batteries (GAB) and the Reliability Analysis Center (RAC) to analyze survivability data for both General Electric and GAB NiCd cells utilized in various spacecraft. For simplicity sake, all mission environments are described as either low Earth orbital (LEO) or geosynchronous Earth orbit (GEO). 'Extreme value statistical methods' are applied to this database because of the longevity of the numerous missions while encountering relatively few failures. Every attempt was made to include all known instances of cell-induced-failures of the battery and to exclude battery-induced-failures of the cell. While this distinction may be somewhat limited due to availability of in-flight data, we have accepted the learned opinion of the specific customer contacts to ensure integrity of the common databases. This paper advances the preliminary analysis reported upon at the 1991 NASA Battery Workshop. That prior analysis was concerned with an estimated 278 million cell-hours of operation encompassing 183 satellites. The paper also cited 'no reported failures to date.' This analysis reports on 428 million cell hours of operation emcompassing 212 satellites. This analysis also reports on seven 'cell-induced-failures.' Author (revised)

N93-20511*# Societe des Accumulateurs Fixes et de Traction, Romainville (France). Space Dept.

CYCLE LIFE STATUS OF SAFT VOS NICKEL-CADMIUM CELLS

Jacques Goualard *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 453-48 Sponsored by NASA. Goddard Space Flight Center; NASA. Lewis Research Center; ESA; ESTEC; AF; Aerospace Corp.; and Naval Surface Warfare Center (For primary document see N93-20490 07-44)

Avail: CASI HC A03/MF A06

The SAFT prismatic VOS Ni-Cd cells have been flown in geosynchronous orbit since 1977 and in low earth orbit since 1983. Parallel cycling tests are performed by several space agencies in order to determine the cycle life for a wide range of temperature and depth of discharge (DOD). In low Earth orbit (LEO), the ELAN program is conducted on 24 Ah cells by CNES and ESA at the European Battery Test Center at temperatures ranging from 0 to 27 C and DOD from 10 to 40 percent. Data are presented up to 37,000 cycles. One pack (X-80) has achieved 49,000 cycles at 10 C and 23 percent DOD. The geosynchronous orbit simulation of a high DOD test is conducted by ESA on 3 batteries at 10 C and 70, 90, and 100 percent DOD. Thirty-one eclipse seasons are completed, and no signs of degradation have been found. The Air Force test at CRANE on 24 Ah and 40 Ah cells at 20 C and 80 percent DOD has achieved 19 shadow periods. Life expectancy is discussed. The VOS cell technology could be used for the following: (1) in geosynchronous conditions--15 yrs at 10-15 C and 80 percent DOD; and (2) in low earth orbit--10 yrs at 5-15 C and 25-30 percent DOD. Author (revised)

N93-20512*# Eagle-Picher Industries, Inc., Joplin, MO. Nickel-Hydrogen Group.

THE 2.5 INCH NICKEL-HYDROGEN DEVELOPMENT

William D. Cook *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 491-50 (For primary document see N93-20490 07-44)

Avail: CASI HC A03/MF A06

The topics covered are presented in viewgraph form and include the following: reasons for developing a 2.5 in. nickel-hydrogen cell; the 2.5 in. nickel-hydrogen development history; RNHC-6-1 cell design; RNHC-6-1 charge voltage at 0.6 A; RNHC-6-1 discharge voltage at 3.0 A; RNHC-6-1 qualification testing; flight unit testing; RNHC-6-1 technical data; technical data for the SAR-10027 Battery; and RNHC-10-1 life test. CASI

N93-20513*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

HUBBLE SPACE TELESCOPE NICKEL HYDROGEN BATTERY SYSTEM BRIEFING

David Nawrocki (Lockheed Missiles and Space Co., Sunnyvale, CA.), David Saldana (Lockheed Technical Operations Co., Crofton, MD.), and Gopal Rao *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 507-52 (For primary document see N93-20490 07-44)

Avail: CASI HC A03/MF A06

The topics covered are presented in viewgraph form and include the following: the Hubble Space Telescope (HST) Mission; system constraints; battery specification; battery module; simplified block diagram; cell design summary; present status; voltage decay; system depth of discharge; pressure since launch; system capacity; eclipse time vs. trickle charge; capacity test objectives; and capacity during tests. CASI

N93-20514*# Centre National d'Etudes Spatiales, Toulouse (France).

AN OVERVIEW OF EIGHT YEARS OF ACTIVITY DEVELOPING FRENCH NICKEL-HYDROGEN TECHNOLOGY

Thierry Jamin and Jean Verniolle (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands.) *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 531-55 (For primary document see N93-20490 07-44)

Avai: CASI HC A03/MF A06

The French and European Space Agencies (CNES, ESA) have been continuously contributing to the development of synthetic aperture focusing technique (SAFT) Ni-H2 technology since 1985. An important effort has been devoted to improving scientific knowledge to enhancing industrial experience and to promoting SAFT as an official back up source for the

European domestic telecommunications market as a battery supplier. Fundamental aspects have been investigated in both industrial and university labs as essential R&D supports. The objectives of this paper are the following: to explain which technical areas, components, and processes have been covered by our studies; to show the results of this work; to establish the status which has been reached and what the standard SAFT individual pressure vessels (IPV) design's main features are; and to present our plans for the near future. Derived from text

N93-20515*# Gates Aerospace Batteries, Gainesville, FL.
RELIABILITY STUDY OF THE NiH2 STRAIN GAGE **c35**
Glenn C. Klein and Donald E. Rash, Jr. (Reliability Analysis Center, Rome, NY.) *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 553-56 (For primary document see N93-20490 07-44)
Avail: CASI HC A03/MF A06

This paper summarizes a joint study by Gates Aerospace Batteries (GAB) and the Reliability Analysis Center (RAC). This study characterizes the reliability and robustness of the temperature compensated strain gages currently specified for sensing of internal pressure of NiH2 cells. These strain gages are characterized as fully encapsulated, metallic foil grids with known resistance that varies with deformation. The measurable deformation, when typically installed on the hemispherical portion of a NiH2 cell, is proportional to the material stresses as generated by internal cell pressures. The internal pressure sensed in this manner is calibrated to indicate the state-of-charge for the cell. This study analyzes and assesses both robustness and reliability for the basic design of the strain gage, the installation of the strain gage, and the circuitry involved. Derived from text

N93-20516*# Eagle-Picher Industries, Inc., Joplin, MO.
HIGH SPECIFIC ENERGY, HIGH CAPACITY NICKEL-HYDROGEN CELL DESIGN
James R. Wheeler *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 569-57 (For primary document see N93-20490 07-44)
Avail: CASI HC A01/MF A06

A 3.5 inch rabbit-ear-terminal nickel-hydrogen cell has been designed and tested to deliver high capacity at a C/1.5 discharge rate. Its specific energy yield of 60.6 wh/kg is believed to be the highest yet achieved in a slurry-process nickel-hydrogen cell, and its 10 C capacity of 113.9 AH the highest capacity yet made at a discharge rate this high in the 3.5 inch diameter size. The cell also demonstrated a pulse capability of 180 amps for 20 seconds. Specific cell parameters, performance, and future test plans are described. Author

N93-20517*# Eagle-Picher Industries, Inc., Joplin, MO. Nickel-Hydrogen Group.
EAGLE-PICHER SPV DEVELOPMENT
Jack Brill and Ron Smith *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 573-59 (For primary document see N93-20490 07-44)
Avail: CASI HC A03/MF A06

The topics covered are presented in viewgraph form and include the following: Eagle-Picher heritage - single pressure vessel (SPV) technology; SPV units in process at Eagle-Pitcher; design features; basic battery design features; cell development considerations; SPV boiler plate cell; cell development activity; SPV cell capacity test - charge and discharge; and current plans. Derived from text

N93-20518*# Johnson Controls, Inc., Milwaukee, WI. Battery Group.
NICKEL-HYDROGEN CPV BATTERY UPDATE
Kenneth R. Jones and Jeffrey P. Zagrodnik *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 593-59 (For primary document see N93-20490 07-44)
Avail: CASI HC A01/MF A06

The multicell common pressure vessel (CPV) nickel hydrogen battery manufactured by Johnson Controls Battery Group, Inc. has completed full flight qualification, including random vibration at 19.5 g for two minutes in each axis, electrical characterization in a thermal vacuum chamber, and mass-spectroscopy vessel leak detection. A first launch is scheduled for late in 1992 or early 1993 by the Naval Research Laboratory (NRL). Specifics of the launch date are not available at this time due to the classified nature of the program. Release of orbital data for the battery is anticipated following the launch. Author

N93-20519*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
BATTERY REVIEW BOARD
Chester Vaughn *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 599-61 (For primary document see N93-20490 07-44)
Avail: CASI HC A03/MF A06

The topics covered are presented in viewgraph form: NASA Battery Review Board Charter; membership, board chronology; background; statement of problem; summary of problems with 50 AH standard Ni-Cd; activities for near term programs utilizing conventional Ni-Cd; present projects scheduled to use NASA standard Ni-Cd; other near-term NASA programs requiring secondary batteries; recommended direction for future programs; future cell/battery procurement strategy; and the NASA Battery Program. Derived from text

N93-20520*# Gates Aerospace Batteries, Gainesville, FL.
DEVELOPMENT OF FIRST GENERATION AEROSPACE NiMH CELLS
Lawrence Tinker, Dan Dell, Tony Wu, and Guy Rampel *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 617-63 (For primary document see N93-20490 07-44)
Avail: CASI HC A03/MF A06

Gates Aerospace Batteries in conjunction with Gates Energy Products (GEP) has been developing NiMH technology for aerospace use since 1990. GEP undertook the development of NiMH technology for commercial cell applications in 1987. This program focused on wound cell technology for replacement of current NiCd technology. As an off shoot of this program small, wound cells were used to evaluate initial design options for aerospace prismatic cell designs. Early in 1991, the first aerospace prismatic cell designs were built in a 6 Ah cell configuration. These cells were used to initially characterize performance in prismatic configurations and begin early life cycle testing. Soon after the 6 Ah cells were on test, several 22 Ah cells were built to test other options. The results of testing of these cells were used to identify potential problem areas for long lived cells and develop solutions to those problems. Following these two cell builds, a set of 7 Ah cells was built to evaluate improvements to the technology. To date results from these tests are very promising. Cycle lives in excess of 2,200 LEO cycles at 50 percent DoD were achieved with cells continuing on test. Results from these cell tests are discussed and data presented to demonstrate feasibility of this technology for aerospace programs. Derived from text

N93-20521*# Tsukuba Space Center, Ibaragi (Japan).
DEVELOPMENT OF NICKEL-METAL HYDRIDE CELL
Saburo Kuwajima, Nolimits Kamimori, Kensuke Nakatani (Sanyo Electric Co. Ltd., Sumoto, Japan.), and Yoshiaki Yano (Sanyo Electric Co. Ltd., Sumoto, Japan.) *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 637-64 (For primary document see N93-20490 07-44)
Avail: CASI HC A02/MF A06

National Space Development Agency of Japan (NASDA) has conducted the research and development (R&D) of battery cells for space use. A new R&D program about a Nickel-Metal Hydride (Ni-MH) cell for space use from this year, based on good results in evaluations of commercial Ni-MH cells in Tsukuba Space Center (TKSC), was started. The results of those commercial Ni-MH cell's evaluations and recent status about the development of Ni-MH cells for space use are described. Author

N93-20522*# Teledyne Brown Engineering, Huntsville, AL.
NICKEL METAL HYDRIDE, A FLIGHT EXPERIMENT
Edward A. Fitzgerald and Francis C. Wessling (Alabama Univ., Huntsville.) *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 645-65 (For primary document see N93-20490 07-44)
(Grant NAGw-812)
Avail: CASI HC A03/MF A06

A nickel metal hydride battery was discharged at high rate in a microgravity environment. Data from the flight is compared to data taken on the earth's surface. Author (revised)

N93-20523*# Eagle-Picher Industries, Inc., Joplin, MO. Electronics Div.
EAGLE-PICHER INDUSTRIES SODIUM SULFUR PROGRAM
Ronald L. Silvey *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 657-67 (For primary document see N93-20490 07-44)
Avail: CASI HC A03/MF A06

Viewgraphs of the sodium sulfur program are presented. Sodium sulfur low earth orbit (LEO) cells are described. Topics covered include cell sizes, areas of improvement, and NaS cell testing. Sodium sulfur cell and battery designs continue to evolve with significant improvement demonstrated in resistance, rechargeability, cycle life, energy density, and electrolyte characterization. CASI

N93-20524*# Energy Science Labs., Inc., San Diego, CA. Thermal Composites Div.
PHASE-CHANGE COMPOSITES TES FOR NICKEL-HYDROGEN BATTERIES
Timothy R. Knowles and Richard A. Meyer *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 679-69 (For primary document see N93-20490 07-44)
(Contract F29601-92-C-0065)
Avail: CASI HC A03/MF A06

Viewgraphs of a discussion on phase-change composites thermal energy storage (TES) for nickel-hydrogen batteries are presented. Topics covered include Ni-H2 thermal control problems; passive thermal control with TES; phase-change composites (PCC); candidate materials; design options; fabrication and freeze-melt cycling; thermal modeling; system benefits; and applications. CASI

N93-20525*# Technochem Co., Greensboro, NC.
CATHODES FOR MOLTEN-SALT BATTERIES
Shyam D. Argade *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 699-71 (For primary document see N93-20490 07-44)
(Contract DAAL01-91-C-0111)
Avail: CASI HC A03/MF A06

Viewgraphs of the discussion on cathodes for molten-salt batteries are presented. For the cathode reactions in molten-salt cells, chlorine-based and sulfur-based cathodes reactants have relatively high exchange current densities. Sulfur-based cathodes, metal sulfides, and disulfides have been extensively investigated. Primary thermal batteries of the Li-alloy/FeS2 variety have been available for a number of years. Chlorine based rechargable cathodes were investigated for the pulse power application. A brief introduction is followed by the experimental aspects of research, and the results obtained. Performance projections to the battery system level are discussed and the presentation is summarized with conclusions. Author (revised)

N93-20526*# Yardney Technical Products, Inc., Pawcatuck, CT.
BIPOLAR RECHARGEABLE LITHIUM BATTERY FOR HIGH POWER APPLICATIONS
Sohrab Hossain, G. Kozlowski, and F. Goebel *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 719-74 (For primary document see N93-20490 07-44)
Avail: CASI HC A03/MF A06

Viewgraphs of a discussion on bipolar rechargeable lithium battery for high power applications are presented. Topics covered include cell chemistry, electrolytes, reaction mechanisms, cycling behavior, cycle life, and cell assembly. CASI

N93-20527*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
DESIGN CONSIDERATIONS FOR RECHARGEABLE LITHIUM BATTERIES
D. H. Shen, C.-K. Huang, E. Davies, D. Perrone, S. Surampudi, and Gerald Halpert *In* NASA. Marshall Space Flight Center, The 1992 NASA Aerospace Battery Workshop Feb. 1993 p 743-76 (For primary document see N93-20490 07-44)
Avail: CASI HC A03/MF A06

Viewgraphs of a discussion of design considerations for rechargable lithium batteries. The objective is to determine the influence of cell design parameters on the performance of Li-TiS2 cells. Topics covered include cell baseline design and testing, cell design and testing, cell design parameters studies, and cell cycling performance. CASI

N93-21220# Alzeta Corp., Santa Clara, CA.
ADIABATIC RADIANT HOT AIR BURNER Final Report, Sep. 1988 - Mar. 1992
R. K. Tidball, B. N. Marshall, F. E. Moreno, and R. L. Pam Mar. 1992 180 p Sponsored by Gas Research Institute and Pacific Gas and Electric Co.
(Contract GRI-5088-234-1741)
(PB93-114486; ALZETA-92-7037-172; GRI-92/0346) Avail: CASI HC A09/MF A02

The report describes a low emissions hot air system for direct product drying and environmental heating. Specific emissions target were 0.5 ppm of nitrogen oxides (NO(x)) and 3.0 ppm of carbon monoxide (CO), as measured in the vitiated stream (mixed process air and combustion products). The firing rate turndown target was 50:1 and temperature range target was 200-1600 F. GRA

N93-21353# Interfacial Sciences, Inc., Santa Clara, CA.
THE ELECTROCHEMICAL OXIDATION OF METHANE FOR FUEL CELLS Annual Report, 1 Jan. 1991 - 31 Jan. 1992
K. W. Frese, J. Wang, and C. Chen 1 Jun. 1992 73 p Sponsored by Gas Research Institute
(Contract GRI-5090-260-2048)
(PB93-110120; GRI-92/0281) Avail: CASI HC A04/MF A01

Methane is an abundant raw material that may be converted to electrical energy in fuel cells or it may be transformed to a liquid fuel such as methanol by suitable electrochemical processes. At present, catalytic electrode materials for methane oxidation are limited to Pt and a few Pt-based alloys. More efficient and cheaper electrode materials are desired to improve the performance and lower the cost of methane anodes in fuel cells. The costs associated with gas reforming would be eliminated in a direct methane fuel cell. A basic research program is being conducted to investigate the factors controlling the performance of various anode materials with the goal of identifying improved electrocatalysts. A specific goal is to improve the oxidation kinetics of CO(ad), a known intermediate in CH4 oxidation. GRA

N93-21455# Aeronautical Radio, Inc., Annapolis, MD.
AN EVALUATION OF R/D NEEDS BASED ON COGENERATION SYSTEM OPERATIONAL EXPERIENCE Final Report, Jan. 1990 - Sep. 1992
Harry W. Brown and F. Samuel Stuber Sep. 1992 192 p
(Contract GRI-5089-293-1870)
(PB93-114494; GRI-92/0409) Avail: CASI HC A09/MF A02

The operational reliability (OR) of 122 natural gas-fueled cogeneration systems was evaluated. The systems ranged in size from small packaged reciprocating systems of less than 100 kW to utility-scale gas turbine systems of greater than 100 MW. Data were collected during visits to the project sites and included copies of daily operations and maintenance (O&M) logs. These data sources were essential to the accuracy and verifiability of OR performance statistics. Statistical data included availability, forced outage rate, and mean time between forced outages. Data analyzed included scheduled and unscheduled outage events, written descriptions of the failure cause, downtime durations, equipment operating hours, and electrical and thermal generation statistics. More than 9,500 maintenance event descriptions are described in a special OR performance analysis data base developed for the project. As a result of this work, a practical framework for collecting and organizing plant O&M data is presented. Illustrative methods are included that demonstrate how reliability improvement opportunities can be identified and analyzed. GRA

N93-21487# Sandia National Labs., Albuquerque, NM.
LOW-TEMPERATURE EMITTER-PASSIVATION FOR SILICON SOLAR CELLS
D. S. Ruby and J. D. Levine (Texas Instruments, Inc., Dallas.) 1992 4 p Presented at the 11th European Photovoltaic Solar Energy Conference, Montreaux, Switzerland, 16 Dec. 1992

(Contract DE-AC04-76DP-00789)
(DE93-002483; SAND-92-0658C; CONF-921229-1) Avail: CASI HC A01/MF A01

A process that provides much of the performance improvement possible from a high-quality emitter passivation while maintaining cell temperatures at or below 400 C was developed. Using atmospheric-pressure chemical-vapor deposition (CVD) Of SiO2 at 400 C followed by a 400 C forming gas anneal, a 3.1-fold increase in the blue response of cells compared to that of unpassivated cells was produced. This has resulted in up to an 11 percent increase in AM1.5G short-circuit current due to the passivating qualities of the CVD oxide. This technique represents a low-cost approach to boost the performance of cells that do not presently employ passivating oxides. It would be of particular value to any silicon cell process in which material or other constraints preclude the use of a high-temperature thermal oxidation for the purpose of emitter passivation. This also applies to cells using material whose bulk lifetime is reduced by multiple high-temperature thermal excursions. DOE

N93-21550# Department of Energy, Washington, DC. Energy Information Administration.
INTERNATIONAL ENERGY OUTLOOK 1992
Apr. 1992 60 p
(PB93-107951; DOE/EIA-0484(92)) Avail: CASI HC A04/MF A01

The report presents the current Energy Information Administration (EIA) assessment of the long-term outlook for international energy markets. The report is provided, as are other EIA reports, as a statistical service for use by managers and international energy analysts and not as a government energy plan. Current U.S. Government policies and foreign government policies are assumed to hold over the projection interval, which extends to the year 2010. GRA

N93-21665# National Geothermal Association, Davis, CA.
DOCUMENTATION OF THE STATUS OF INTERNATIONAL GEOTHERMAL POWER PLANTS AND A LIST BY COUNTRY OF SELECTED GEOTHERMALLY ACTIVE GOVERNMENTAL AND PRIVATE SECTOR ENTITIES
Oct. 1992 378 p
(Contract DE-FG07-89ID-12850)
(DE93-002273; DOE/ID-12850/6) Avail: CASI HC A17/MF A03

This report includes the printouts from the International Geothermal Power Plant Data Base and the Geothermally Active Entity Data Base. Also included are the explanation of the abbreviations used in the power plant data base, maps of geothermal installations by country, and data base questionnaires and mailing lists. DOE

N93-21732# International Fuel Cells Corp., South Windsor, CT.
ADVANCED WATER-COOLED PHOSPHORIC ACID FUEL CELL DEVELOPMENT
Jul. 1992 16 p
(Contract DE-AC21-88MC-24221)
(DE93-003490; DOE/MC-24221/3144; FCR-12383) Avail: CASI HC A03/MF A01

The Advanced Water Cooled Phosphoric Acid Fuel Cell Development Program is being conducted by International Fuel Cells Corporation (IFC) to improve the performance and minimize the cost of water-cooled, electric utility phosphoric acid fuel cell stacks. The program adapts the existing on-site Configuration B cell design to electric utility operating conditions and introduces additional new design features. Task 1 consists of the conceptual design of a full-scale electric utility cell stack that meets program objectives. Tasks 2 and 3 develop the materials and processes required to fabricate the components that meet the program objective. The design of the small area and two 10-ft(exp 2) short stacks is conducted in task 4. The conceptual design also is updated to incorporate the results of material and process developments, as well as results of stack tests conducted in task 6. Fabrication and assembly of the short stacks are conducted in task 5 and subsequent tests are conducted in task 6. The Contractor expects to enter into a contract with the Electric Power Research Institute (EPRI) to assemble and endurance test the second 10-ft(exp 2) short stack. The management and reporting functions of task 7 provide DOE/METC with program visibility through required documentation and program reviews. This report describes the cell design and development effort that is being conducted to demonstrate, by subscale stack test, the technical achievements made toward the above program objectives. DOE

N93-21781# Energy Research Corp., Danbury, CT.
GASIFIERS OPTIMIZED FOR FUEL CELL APPLICATIONS
G. Steinfeld, J. Fruchtman, W. B. Hauserman, A. Lee, and S. J. Meyers 1992 9 p Presented at the US DOE Contractors Review Meeting on Gasification and Gas Stream Cleanup Systems, Morgantown, WV, 15-17 Sep. 1992
(Contract DE-AC21-90MC-27227)
(DE93-003486; DOE/MC-27227/93/C0130; CONF-920951-50) Avail: CASI HC A02/MF A01

Conventional coal gasification carbonate fuel cell systems are typically configured so that the fuel gas is primarily hydrogen, carbon monoxide, and carbon dioxide, with waste heat recovery for process requirements and to produce additional power in a steam bottoming cycle. These systems make use of present day gasification processes to produce the low to medium Btu fuel gas which in turn is cleaned up and consumed by the fuel cell. These conventional gasification/fuel cell systems have been studied in recent years projecting system efficiencies of 45-53 percent (HHV). Conventional gasification systems currently available evolved as stand-alone systems producing low to medium Btu gas fuel gas. The requirements of the gasification process dictates high temperatures to carry out the steam/carbon reaction and to gasify the tars present in coal. The high gasification temperatures required are achieved by an oxidant which consumes a portion of the feed coal to provide the endothermic heat required for the gasification process. The thermal needs of this process result in fuel gas temperatures that are higher than necessary for most end use applications, as well as for gas cleanup purposes. This results in some efficiency and cost penalties. This effort is designed to study advanced means of power generation by integrating the gasification process with the unique operating characteristics of carbonate fuel cells to achieve a more efficient and cost effective coal based power generating system. This is to be done by altering the gasification process to produce fuel gas compositions which result in more efficient fuel cell operation and by integrating the gasification process with the fuel cell as shown in Figure 2. Low temperature catalytic gasification was chosen as the basis for this effort due to the inherent efficiency advantages and compatibility with fuel cell operating temperatures. DOE

N93-21826# Case Western Reserve Univ., Cleveland, OH. Center for Electrochemical Sciences.
ELECTROCHEMICAL CHARACTERISTICS OF ACID ELECTROLYTES FOR FUEL CELLS Final Report, 1 Jan. 1989 - 30 Jun. 1991
D. Gervasio, M. Razaq, A. Razaq, R. Adzic, K. Kanamura, and E. B. Yeager 31 Jan. 1992 71 p Sponsored by Gas Research Inst., Chicago, IL
(Contract GRI-5084-260-1108)
(PB93-124907; GRI-92/0189) Avail: CASI HC A04/MF A01

The electrochemical evaluation of new perfluorinated fuel cell electrolytes provided by GRI contractors at Clemson and Iowa shows the kinetics for O2 reduction on Pt improves with these acids compared to with phosphoric acid. The improvement is mainly due to the lesser tendency of these acids to absorb on Pt. Kinetics do not have a strong dependence on pH or O2 solubility when mass transport is not involved. Concentrated sulfonyl acids were usually found to wet Teflon resulting in the flooding of Teflon-bonded gas fed electrodes and poor performance at high current densities. These perfluorinated electrolytes were, however, found to be useful as performance enhancing additives to concentrated phosphoric acid in some cases. The alpha, omega-bis-phosphonic acid with a perfluoroethylene bridge gave superior performance compared to phosphoric acid at elevated temperatures (up to 200 C) for 500 hours. Bis-phosphonic acids with higher CF2 to PO3H2 ratios dehydrated more readily at elevated temperatures, resulting in resistive voltage losses. New perfluorinated phosphonic acid containing olefins were found to be polymerizable. This suggests that with a reasonable synthetic effort, new kinds of ionomer membrames are attainable, and these may be superior to Nafion for fuel cell applications. GRA

N93-21833# Discovery Center of Idaho, Inc., Boise.
BURST OF ENERGY

1992 66 p
(Contract DE-FG02-91ER-75645)
(DE93-005058; DOE/ER-75645/1) Avail: CASI HC A04/MF A01

The Discovery Center of Idaho (DCI) was the recipient of a grant from US DOE's Museum Science Education Program to build six permanent energy related exhibits to provide the public with hands-on experience with energy issues. Because of its volunteer support system, DC was able to build eleven exhibits. These exhibits are described and photographs are included. The signs used for the exhibits are reproduced as well as the materials used to advertise them to the public. Examples of DCI's newsletter are included that mention the new exhibits. DOE

N93-21961# Sandia National Labs., Albuquerque, NM.
ADVANCED CONTROL STRATEGIES FOR WIND TURBINES
L. L. Schluter and William A. Vachon (Vachon, William A. and Associates, Inc., Manchester, MA.) 1992 11 p Presented at the Windpower 1992, Seattle, WA, 19-23 Oct. 1992
(Contract DE-AC04-76DP-00789)
(DE93-003252; SAND-92-1162C; CONF-921049-4) Avail: CASI HC A03/MF A01

As wind turbines become more complex and begin to incorporate variable speed operation, control algorithms that enable the wind turbine to operate as efficiently as possible will become more complicated. Also, most current control strategies do not take into account factors such as wake effects from upstream turbines and the fact that different turbine sites can have significantly different wind regimes. To aid a windfarm operator in developing appropriate control strategies, a computer code entitled ASYM has been developed at Sandia National Laboratories. ASYM is a wind turbine simulation program that can be used to evaluate different control strategies. This paper briefly describes ASYM and presents results from the code when used for evaluating control options for both variable-speed and constant-speed control. The code synthesizes dynamic wind speeds on a second-by-second basis in the time domain that conforms to a predetermined spectral content governed by the surface roughness length scale and the hourly average wind speed. The simulated wind speeds then drive a series of wind turbine (WT) control algorithms that predict key WT operational parameters such as number of annual starts and stops, annual energy production, and annual fatigue damage at a critically stressed joint on the WT. This paper also discusses future plans to improve and validate ASYM and to incorporate a comprehensive economics model and advanced control strategies such as fuzzy control, adaptive control, and expert systems. It has been shown that processes using fuzzy control algorithms operate more smoothly and more efficiently than processes that are controlled using classical methods. Fuzzy control is briefly explained and an example of its application to a wind turbine is given. The future plans include a continuing involvement with active wind plant operators who can provide feedback regarding the usefulness of the analytical tool and the validity of findings. DOE

N93-20479# National Space Development Agency, Ibaraki (Japan). Parts and Material Lab.
SOLAR CELL CALIBRATION BY BALLOON FLIGHT [TAIYOU DENCHI SERU NO BARUN FURAITO NI YORU KOUSEI]
Sumio Matsuda, Takashi Tamura, and Masato Uesugi *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 297-298 In JAPANESE (For primary document see N93-20410 07-12)
Avail: CASI HC A01/MF A03

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N93-20166 Essex Univ., Colchester (England).
STUDIES OF OZONE DEPOSITION Ph.D. Thesis
Alison J. Simmons 1992 372 p
Avail: Univ. Microfilms Order No. BRD-97201

Five methods were used to investigate the deposition of ozone. The methods were developed for use where necessary, and the advantages and disadvantages of each technique were considered, taking into account the practical aspects as well as the theoretical basis of each method. The profile method was used over grass surfaces and over barley. Average values for the deposition velocity 1 metre over grass ranged from 0.39-0.85 cm s(exp -1). The average deposition velocity over barley was 1.29 cm s(exp -1). Eddy diffusivity values for sensible heat were obtained 2 metres above a grass surface, using the Bowen ratio technique. They were found to be slightly higher than momentum diffusivity values at a height of 1 metre over the same surface, measured by the profile technique. From the eddy correlation technique, the deposition velocity of ozone over barley measured at 5.6 m, was found to be 1.0 cm s(exp -1). This is in agreement with the profile measurement at 1 metre as the deposition velocity is expected to decrease with height if the flux layer is constant. The box method was used to obtain surface resistance values of various surfaces, to ozone deposition. The range of resistances over grass was 0.7-3.8 s cm(exp -1), using average values, which compared with the average values obtained by the profile method of 0.5-2.1 s cm(exp -1). Of the building materials that were investigated glass had the highest resistance of 38 s cm(exp -1), and bricks the lowest of 0.4 cm (exp -1). Resistances over soils ranged from 0.11-1.49 s cm(exp -1), whereas over sand the resistances were found to range from 0.23-6.41 s cm(exp -1). Deposition velocities and surface resistances were measured using the open top chamber over grass. Average values were found to be 0.6 cm s(exp -1) for the deposition velocity and 3.4 cm (exp -1) for the surface resistance of grass. Generally good agreement was found between the methods, but there is a need for further experimentation in this area as development of some of the techniques could be useful. Dissert. Abstr.

N93-20925# Institut Royal Meteorologique de Belgique, Brussels.
CLIMATOLOGICAL STUDY OF OZONE IN THE BOUNDARY LAYER ABOVE BELGIUM [KLIMATOLOGISCHE STUDIE VAN OZON IN DE GRENSLAAG BOVEN BELGIE]
Ann Dom 1992 57 p In DUTCH
(Misc-SER-A-127; ETN-93-92995) Avail: CASI HC A04/MF A01

A contribution was made to improve the understanding of the behavior and the formation of ozone in the boundary layer. Measurements from five stations of the Belgian automatic measuring network for air pollution were statistically analyzed. The ozone concentrations show a pronounced daily and annual evolution due to variations in the meteorological conditions which determine the ozone decay. The daily evolution can be explained by dry deposition at the soil during the night, downward transport in the morning and photochemical production during the day. The ozone maximum observed during the Summer (1980-1985) shifted to the Spring (1986-1990). During Autumn and Winter the ozone concentration is mainly determined by atmospheric transport processes, and the daily variation is less pronounced. The concentrations are not much affected by local circumstances. Recommendations for future studies are given. ESA

N93-21011# Environmental Protection Agency, Cincinnati, OH. Risk Reduction Engineering Lab.
INTELLIGENT PROCESSING EQUIPMENT WITHIN THE ENVIRONMENTAL PROTECTION AGENCY
Daniel G. Greathouse and Richard P. Nalesnik (Environmental Protection Agency, Washington, DC.) 1992 9 p Presented at the Federal Conference on Intelligent Processing Equipment, San Jose, CA, 3-5 Dec. 1991
(PB92-217330; EPA/600/A-92/186) Avail: CASI HC A02/MF A01

Protection of the environment and environmental remediation requires the cooperation, at all levels, of government and industry. Intelligent processing equipment, in addition to other artificial intelligence based tools, has been used by the Environmental Protection Agency (EPA) to provide personnel safety and improve the efficiency of those responsible for protection and remediation of the environment. These exploratory efforts demonstrate the feasibility and utility of expanding development and widespread use of these tools. A survey of current intelligent processing equipment applications in the Agency is presented and is followed by a brief discussion of possible uses in the future. GRA

N93-21028# Deputy Assistant Secretary of Defense (Environmental Quality), Washington, DC.
REPORT ON ENVIRONMENTAL REQUIREMENTS AND PRIORITIES
May 1992 278 p
(PB92-208198) Avail: CASI HC A13/MF A03

The Report on Environmental Requirements and Priorities was prepared

pursuant to Section 358 of the 1990 Defense Authorization Act (Public Law 101-189). The report addresses the long-range environmental challenges and goals of the Department of Defense (DoD), and describes the current status of DoD environmental programs, resources, policies, and priorities. The information addresses regulatory compliance, installation restoration, and the full range of other DoD environmental programs ranging from protection and enhancement of natural and cultural resources to environmental planning and assessment. GRA

N93-21211# National Geophysical Data Center, Boulder, CO. World Data Center A for Solid Earth Geophysics.

GLOBAL CHANGE DATA BASE TRAINING EXERCISE MANUAL. EXPLORING EARTH'S ENVIRONMENT: AFRICA AS AN EXAMPLE

Michelle Fulk, ed. (Clark Univ., Worcester, MA.) and David Hastings, ed. Jun. 1992 167 p Sponsored in part by Interagency Working Group on Data Management for Global Change; International Geosphere-Biosphere Programme's Working Group on Data and Information Systems; and International Council of Scientific Unions Research

(PB92-224682; SE-48) Avail: CASI HC A08/MF A02

The manual attempts to provide economical and convenient ways for researchers and schools to explore the global environment, and to analyze phenomena of global change. The complete package includes the data base (extracted from the Global Change Data Base, supplemented with selected data sets for Africa), documentation for the data base, this workshop manual, and the user's choice of raster Geographic Information System (GIS) including its own documentation and training materials. Presently, most research on the global environment has focused on either localized detailed studies (such as with high-resolution satellite imagery), or very coarse-scale (2.5 to 5 degree resolution) regional and global modeling studies primarily of the oceans or atmosphere. In contrast, relatively little has been done at medium scales ranging from 1/4 to 100 km (approximately .3 to 60 arc-minutes), with the exception of pioneering work with the satellite-derived 'vegetation index' and other products derived from NOAA's AVHRR sensor. Other existing data sets at these medium scales are sketchily developed and inadequately accessible in usable form. Yet, information at this scale can reveal interesting phenomena that may be significant over nations, regions, continents, and the world. It can provide a useful context for high resolution studies of internal interest to many countries. Thus, it is with the goal of furthering research at this medium resolution, and linking it with work at the two extremes, that the Global Change Data Base has been inspired. GRA

N93-21216# Environmental Protection Agency, Research Triangle Park, NC.

STATE AIR POLLUTION CONTROL PROGRAMS: A PROFILE REPORT

William F. Hamilton Oct. 1992 25 p

(PB93-122364; EPA/452/R-92/006) Avail: CASI HC A03/MF A01

The report provides information which states can use to compare certain elements of their Air Pollution Control Programs to those of other states. Program elements included in the report are enforcement, monitoring, administration, permitting/new source review, regulatory planning and development, and control of air toxics. GRA

N93-21217# Environmental Protection Agency, Annapolis, MD. Chesapeake Bay Program.

TRENDS IN NITROGEN IN THE CHESAPEAKE BAY, 1984-1990

Jun. 1992 61 p Sponsored by EPA

(Contract EPA-68-WO-0043)

(PB93-122174; CBP/TRS-68/92) Avail: CASI HC A04/MF A01

The trend analysis presented in the document is based on data compiled through the Chesapeake Bay Water Quality Monitoring Program that was initiated in June 1984. In 1987, the Chesapeake Bay Agreement expanded and refined previous commitments of the signatories to reverse apparent declines in the quality and productivity of the bay. The improvement and maintenance of water quality in the bay were identified as the most critical elements in the goal to ensure the productivity of the bay's living resources. To reach the goal, nitrogen and phosphorus loads entering the mainstem of the bay were targeted to be reduced by 40 percent between the 1985 baseline year and the year 2000. Although most of the progress toward the targeted nutrient reduction goal has been achieved with respect to phosphorus, there have been some decreases in nitrogen inputs to the bay from both point and nonpoint sources. GRA

N93-21238# National Oceanic and Atmospheric Administration, Silver Spring, MD. Air Resources Lab.

RELATIONSHIP BETWEEN OZONE CONCENTRATIONS AND AIR TRANSPORT OVER WESTERN ARIZONA

Joe F. Boatman, Charles C. VanValin (Colorado Univ., Boulder.), and Stan W. Wilkison Sep. 1992 36 p

(PB93-114007; NOAA-TM-ERL-ARL-197) Avail: CASI HC A03/MF A01

The high concentrations (greater than 100 ppbv) of O3 measured near the surface in Yuma, Arizona, are primarily the result of the transport of O3 and its precursors from the heavily populated southern California coastal region extending from Oxnard to San Diego. The highest O3 concentrations are measured when the wind speeds are low, resulting in transport times of 36 to 48 hours for the distance from the coastal regions to the vicinity of Yuma. High daytime O3 concentrations are associated with low nighttime concentrations (less than 10 ppbv) caused by the destruction of O3 by NO, most of which is added to the atmosphere from vehicular traffic near the O3 monitoring station. Wind speed, as a regulator of the degree of air mass dilution during transport, was sometimes a determining factor in the occurrence of high O3 concentrations at Yuma. Analysis of air mass back trajectories indicated that the central and northern parts of the western Arizona border are also subject to the impact of pollution from southern California. GRA

N93-21345# Environmental Protection Agency, Washington, DC. Associate Administrator for Communications and Public Affairs.

PRESERVING OUR FUTURE TODAY: YOUR GUIDE TO THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Oct. 1991 36 p

(PB92-226190; EPA/21K-1012) Avail: CASI HC A03/MF A01

The following contents are presented: new directions for the 1990s: voluntary action; people; water; new directions for the 1990s: protecting natural resources; new directions for the 1990s: economic incentives; air; new directions for the 1990s: reducing risks; contaminants and radiation; new directions for the 1990s: pollution prevention; waste; the global environment; the role of science; enforcing the laws; and looking ahead. GRA

N93-21347# National Academy of Sciences - National Research Council, Washington, DC.

OPPORTUNITIES IN APPLIED ENVIRONMENTAL RESEARCH AND DEVELOPMENT Final Report

1991 170 p

(Contract EPA-68-D80079)

(PB92-223189) Avail: CASI HC A08/MF A02

There are many opportunities in applied environmental research and development. In investigating such opportunities, the committee attempted to look into the future; therefore, the report is not an exhaustive scientific report, but rather an attempt to summarize the opinions of experts in several fields. Four areas were investigated by the committee with the assistance of participants in a series of workshops: waste reduction, ecosystem and landscape change, anticipatory research, and long-term chemical toxicity. One fundamental question is whether the EPA and other agencies should fund only research linked specifically to its legislated regulatory objectives or whether it should also anticipate new or emerging, unregulated environmental problems. The committee believes that research is an essential foundation of environmental protection and that scientifically based advisory panels should play a larger and more visible role in fostering improvements in environmental science, such as developing high-quality research institutions and advising environmental agencies on ways to link research effectively with policy and management decision making. GRA

N93-21378# Environmental Protection Agency, Washington, DC. Information Management and Services Div.

PUBLIC ACCESS: A HOW TO GUIDE

Jul. 1991 197 p

(PB93-111029; EPA/220/B-92/021) Avail: CASI HC A09/MF A03

Over the last several years, the EPA has been experiencing an increase in demand from the public for information maintained by the Agency. In order to meet the demand, EPA's offices have been responding in a variety of ways, including using information centers, clearinghouses, dockets, hotlines, and databases to make the information available. The Office of Information Resources Management (OIRM), in its role as National Program

Manager for Public Access, has been promoting coordination and enhancement of these public access activities to increase efficiency in providing information. The Public Access guide is another one of the steps that OIRM is taking to promote the increased efficiency. GRA

N93-21384# Energy International, Inc., Bellevue, WA.
ENERGY UTILIZATION AND GREENHOUSE GAS EMISSIONS: TRANSPORTATION SECTOR
K. G. Darrow, Jr. Jun. 1992 33 p Sponsored by Gas Research Institute
(Contract GRI-5090-810-2035)
(PB93-110161; GRI-92/0182) Avail: CASI HC A03/MF A01

The objective of the report is to compare the emissions of greenhouse gases for alternative end-use technologies in the transportation sector. Scientists assert that global warming is occurring and will continue to occur as a result of increasing concentrations of certain gases in the atmosphere. Carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) are the focus of this analysis because they are believed to cause three-fourths of the global warming effect and because energy production and use are a significant source of these emissions. Greenhouse gas emissions in the energy sector occur during energy production, conversion, transportation, and end-use. This analysis compares alternative transportation sector fuel/technology choices in terms of their total fuel-cycle emissions of greenhouse gases. The emphasis of this report is on the end use comparison. The fuel-cycle emissions comparison was developed in a companion report. Author (GRA)

N93-21466# Environmental Protection Agency, Washington, DC. Office of Enforcement.
ENFORCEMENT IN THE 1990'S PROJECT: RECOMMENDATIONS OF THE ANALYTICAL WORKGROUPS
Oct. 1991 398 p
(PB92-224286; EPA-22E-2000) Avail: CASI HC A17/MF A04

Enforcement has re-emerged as a leading tool of environmental policy in recent years. In the Fall of 1989, the US Environmental Protection Agency's (EPA) Enforcement Management Council undertook to develop specific ideas for improving the enforcement process, with particular emphasis upon strengthening the intergovernmental relationship and reviewing the EPA enforcement management systems to better assess the environmental impact of the enforcement program. In order to capture a wide range of experiences and perspectives, the council surveyed approximately 50 environmental officials inside and outside of the agency. In addition to the two subjects identified initially, the interviewees solicited their opinions about other enforcement issues that warranted analysis. Ultimately, the Council identified the six discrete enforcement topics which are addressed in the workgroup reports of the enforcement in the 1990's project. GRA

N93-21473# Environmental Protection Agency, Research Triangle Park, NC. Air and Energy Engineering Research Lab.
TECHNOLOGIES OPTIONS FOR ACID RAIN CONTROL Book Chapter, May - Oct. 1990
Frank T. Princiotta 1992 22 p
(PB93-106854; EPA/600/A-92/216) Avail: CASI HC A03/MF A01

Acid rain control options available to the electric utility industry are discussed. They include coal switching, flue gas desulfurization, and such emerging lower cost technologies as limestone injection multistage burners (LIMB) and advanced silicate (ADV-CATE) (both developed by the Environmental Protection Agency (EPA)) selective use of gas to reduce nitrogen oxides and sulfur dioxide in coal-fired boilers, and the use of integrated coal gasification combined cycle (IGCC) technology. GRA

N93-21494# Research Triangle Inst., Research Triangle Park, NC.
SUMMARY REPORT FOR THE NATIONAL ATMOSPHERIC DEPOSITION PROGRAM NATIONAL TRENDS NETWORK (NADP/NTN) SITE VISITATION PROGRAM Report, Oct. 1988 - Sep. 1989
W. C. Eaton, C. E. Moore, R. W. Murdoch, R. C. Shores, and D. A. Ward Dec. 1991 110 p
(Contract EPA-68-D8-0001)
(PB92-219823; EPA/600/R-92/152) Avail: CASI HC A06/MF A02

The proper collection of precipitation and the accurate measurement of its constituents are important steps in attaining a better understanding of the distribution and effects of acid rain in the United States. One of NAPAP Task Group 4's major programs concerns wet deposition monitoring. One of that program's project, 4A-15, 'Quality Assurance Support for Wet Deposition Monitoring', is sponsored by the U.S. Environmental Protection Agency (EPA) to evaluate the sample collection process and provide technical assistance to the NADP/NTN network through a site visitation program. Research Triangle Institute, as contractor to EPA, conducts these visits. If deficiencies or nonstandard procedures are noted, the site operator and supervisor are notified. Brief reports are sent to the EPA Project Officer, the NADP/NTN Quality Assurance Manager, and others. In this way, necessary changes can be made promptly. All NADP/NTN sites were visited in 1985-1986. A second round of visits began in October 1986, with the goal of visiting approximately one-third of the 200 sites each year over the next three years. The document is a summary report of the findings from the 1988-1989 (Fiscal Year 1989) site visitation program to 72 of the sites of the NADP/NTN network. GRA

N93-21495# Battelle Columbus Labs., OH.
ATLANTA OZONE PRECURSOR MONITORING STUDY DATA REPORT
L. J. Purdue (Environmental Protection Agency, Research Triangle Park, NC.), J. A. Reagan (Environmental Protection Agency, Research Triangle Park, NC.), W. A. Lonneman (Environmental Protection Agency, Research Triangle Park, NC.), T. C. Lawless (Environmental Protection Agency, Research Triangle Park, NC.), R. J. Drago (Environmental Protection Agency, Research Triangle Park, NC.), G. Zalaquet, M. Holdren, D. Smith, A. Pate, and B. Buxton et al Sep. 1992 168 p Prepared in cooperation with ManTech Environmental Technology, Inc., Research Triangle Park, NC
(Contract EPA-68-D1-0111)
(PB92-220656; EPA/600/R-92/157) Avail: CASI HC A08/MF A02

Monitoring was conducted during the summer of 1990 to address the measurement of ozone (O3) and ozone precursors in Atlanta, Georgia. Data were collected using automated gas chromatography. Resolved individual species were detected via a flame ionization detector (FID) and an electron capture detector (ECD). The study area included six continuous and six enhancement sites located in and around the greater metropolitan Atlanta area. The collected data provide an information base to support the development and implementation of improved strategies to reduce O3 in metropolitan areas. This data base contains more than 300,000 hourly measurements of the various parameters and species identified for the study. GRA

N93-21496# National Academy of Sciences - National Research Council, Washington, DC.
HUMAN EXPOSURE ASSESSMENT FOR AIRBORNE POLLUTANTS: ADVANCES AND OPPORTUNITIES Final Report
1991 334 p
(PB92-223247; ISBN-0-309-04284-4; LC-90-63324) Avail: CASI HC A15/MF A03

Most people in the United States spend more time indoors that outdoors. Yet, many air pollution regulations and risk assessments focus on outdoor air. These often overlook contact with harmful contaminants that may be at their most dangerous concentrations indoors. The report explores the need for strategies to address indoor and outdoor exposures and examines the methods and tools available for finding out where and when significant exposures occur. It includes the following: (1) a conceptual framework and common terminology that investigators from different disciplines can use to make more accurate assessments of human exposure to airborne contaminants; (2) an update of important developments in assessing exposure to airborne contaminants: ambient air sampling and physical chemical measurements, biological markers, questionnaires, time-activity diaries, and modeling; and (3) a series of examples of how exposure assessments have been applied -- properly and improperly -- to public health issues and how the committee's suggested framework can be brought into practice. The report will provide important insights to improve risk assessment, risk management, pollution control, and regulatory programs. GRA

N93-21501# Foster-Miller Associates, Inc., Waltham, MA.
ANALYSIS OF AIRCRAFT NOISE LEVELS IN THE VICINITY OF START-OF-TAKEOFF ROLL AT BALTIMORE-WASHINGTON INTERNATIONAL AIRPORT Final Report, Nov. 1991 - May 1992
Richard D. Horonjeff (Harris, Miller, Miller and Hanson, Inc., Lexington,

MA.) May 1992 92 p
(Contract DTRS-57-89-00009)
(PB92-221605; DOT-VNTSC-FAA-92-5; DOT/FAA/EE-92/01) Avail: CASI HC A05/MF A01

The sound level prediction accuracy of the Federal Aviation Administration's Integrated Noise Model (INM) is receiving closer scrutiny today than at its inception due to a shifting emphasis in the model's application. In addition to the traditional land use planning application, the INM is now used as resource arbiters for local and federally funded noise mitigation programs. The increased model scrutiny has led to a reinspection of modeling assumptions in the vicinity of start-of-takeoff roll and the subsequent need for a well documented empirical database. The study focused on the gathering of such a database. The completed database consists of measured sound exposure levels (SEL's) and maximum A-weighted sound levels at five sites in the hemicircle behind the aircraft at brake release and at distances of 2,000 to 4,000 ft from the brake release point. Independent variables include measurement site/runway geometry, aircraft type, engine type, aircraft gross weight, wind speed and direction, temperature, relative humidity, barometric pressure, aircraft ground roll distance versus time, and time to liftoff. The information is all contained in standard dBase 3 database files. Findings shown in the report include the effects on SEL of wind speed and direction, and the interaction effects of wind speed direction and measurement site location. Also discussed are comparisons of measured SEL's and the predicted values of INM Version 3.10. GRA

N93-21649# National Oceanic and Atmospheric Administration, Boulder, CO. Wave Propagation Lab.
CONPLT: A PROGRAM TO GENERATE CONTOURS FROM HARPO/HARPA ENVIRONMENTAL MODELS. DATA DOCUMENTATION
J. A. Harlan (Colorado Univ., Boulder.), T. M. Georges, and R. Michael Jones Apr. 1992 52 p
(PB92-218544; NOAA-TM-ERL-WPL-221; NOAA/SW/DK-92/008A) Avail: CASI HC A04/MF A01

The manual describes a FORTRAN computer program, CONPLT, that will generate plotting-command files for contour plots of the environmental models (e.g., sound speed, current or wind velocity, temperature) used with the acoustic ray tracing programs HARPO (underwater acoustics) and HARPA (atmospheric acoustics). Contours of environmental model parameters can be obtained in any vertical or horizontal slice through three-dimensional models. A companion report, PSGRAPH -- A Plotting Program for PC-HARPO, PROFILE, CONPLT, and EIGEN describes an associated computer program that produces post script files as well as screen graphics for PC-compatible computers. GRA

N93-21654# Corvallis Environmental Research Lab., OR.
SYNOPTIC APPROACH TO CUMULATIVE IMPACT ASSESSMENT: A PROPOSED METHODOLOGY
Scott G. Leibowitz, Brooke Abbruzzese (ManTech Environmental Technology, Inc., Corvallis, OR.), Paul Adamus (ManTech Environmental Technology, Inc., Corvallis, OR.), Larry Hughes (ManTech Environmental Technology, Inc., Corvallis, OR.), and Jeffrey Irish (ManTech Environmental Technology, Inc., Corvallis, OR.) Oct. 1992 138 p Prepared in cooperation with ManTech Environmental Technology, Inc., Corvallis, OR; and Word Design, Corvallis, OR
(PB93-100147; EPA/600/R-92/167) Avail: CASI HC A07/MF A02

The report provides resource managers and technical staff with an approach for evaluating the cumulative environmental effects of individual human impacts on the environment, particularly with respect to wetlands. The document is intended to give the reader a general understanding of cumulative impacts and to describe how a synoptic assessment is produced. Although specifically designed for use in wetlands permit evaluation under the Clean Water Act (CWA), the method can be applied to cumulative impact assessment in general. A second objective of the report is to encourage resource managers responsible for wetland protection to consider and view wetlands within a landscape context. GRA

N93-21655# Environmental Protection Agency, Washington, DC. Office of Wetlands, Oceans, and Watersheds.
PROTECTING THE NATION'S WETLANDS, OCEANS, AND WATERSHEDS: AN OVERVIEW OF PROGRAMS AND ACTIVITIES
Jul. 1992 24 p Color illustrations reproduced in black and white
(PB93-105609; EPA/840/S-92/001) Avail: CASI HC A03/MF A01

Wetlands, oceans, and watersheds are vitally linked; their health depends on the water quality of the particular watersheds that feed them. Because of their interconnectedness, an integrated, cooperative approach engaging the various water programs within the U.S. Environmental Protection Agency (EPA) is the most effective way to manage and protect these irreplaceable resources. EPA's Office of Wetlands, Oceans, and Watersheds (OWOW) was created in April 1991 to integrate the protection and management of our Nation's watersheds, coastal and marine waters, and wetlands. OWOW combines the agency's responsibilities for abating nonpoint source pollution; restoring and protecting wetlands, lakes, rivers, coastal, and marine environments; and providing leadership for surface monitoring and water quality assessment activities. The booklet discusses these topics. GRA

N93-21656# ManTech Environmental Technology, Inc., Corvallis, OR.
USE OF ECOREGIONS IN BIOLOGICAL MONITORING
Robert M. Hughes, Steven A. Heiskary (Minnesota Pollution Control Agency, Minneapolis.), William J. Matthews (Oklahoma Univ., Oklahoma City.), and Chris O. Yoder (Environmental Protection Agency, Columbus, OH.) 1992 32 p Presented at the Symposium on Biological Monitoring of Freshwater Ecosystems, West Lafayette, IN, 29 Nov. - 1 Dec. 1990 Sponsored by Corvallis Environmental Research Lab., OR Prepared in cooperation with Minnesota Pollution Control Agency, St. Paul, Oklahoma Univ., Kingston, and Ohio State Environmental Protection Agency, Columbus
(PB93-106730; EPA/600/A-92/204) Avail: CASI HC A03/MF A01

In order to better manage populations of lakes and streams it is useful to have some form of lake and stream classification. In biological monitoring programs, an appropriate geographic framework is useful for developing estimates of organisms likely to be collected and conditions likely to be encountered. As assemblage and water quality data bases and statistical software have become available, they have been used to frame regions. Others have compared aquatic ecosystems patterns with various environmental variables. The purpose of the paper is to compare fish faunal regions and ecoregions, summarize the experience of two states that use ecoregions as management units, and summarize the concerns of workshop participants about the use of ecoregions. GRA

N93-21666# Tellus Inst., Inc., Boston, MA.
THE POTENTIAL FOR BIOMASS TO MITIGATE GREENHOUSE GAS EMISSIONS IN THE NORTHEASTERN US
S. S. Bernow, K. Gurney, G. Prince, and M. Cyr Apr. 1992 197 p
(Contract DE-FG05-83OR-21389)
(DE93-002800; DOE/OR-21389/38) Avail: CASI HC A09/MF A03

This study, for the Northeast Regional Biomass Program (NRBP) of the Coalition of Northeast Governors (CONEG), evaluates the potential for local, state and regional biomass policies to contribute to an overall energy/biomass strategy for the reduction of greenhouse gas releases in the Northeastern United States. Biomass is a conditionally renewable resource that can play a dual role: by reducing emissions of greenhouse gases in meeting our energy needs; and by removing carbon from the atmosphere and sequestering it in standing biomass stocks and long-lived products. In this study we examine the contribution of biomass to the energy system in the Northeast and to the region's net releases of carbon dioxide and methane, and project these releases over three decades, given a continuation of current trends and policies. We then compare this Reference Case with three alternative scenarios, assuming successively more aggressive efforts to reduce greenhouse gas emissions through strategic implementation of energy efficiency and biomass resources. Finally, we identify and examine policy options for expanding the role of biomass in the region's energy and greenhouse gas mitigation strategies. DOE

N93-21684# MBC Applied Environmental Sciences, Inc., Costa Mesa, CA.
THE 6TH CONFERENCE PROCEEDINGS OF THE PACIFIC OCS REGION INFORMATION TRANSFER MEETING
Sep. 1991 220 p Conference held in Santa Barbera, CA, 29-31 May 1991
(Contract DI-14-12-0001-30525)
(PB93-119600; OCS/MMS-91/0070) Avail: CASI HC A10/MF A03

The report documents the proceedings of the Sixth Pacific Outer Continental Shelf (OCS) Region's Information Transfer Meeting (ITM) held

May 29-31, 1991 in Santa Barbara, CA. The ITM was sponsored by the U.S. Department of Interior, Minerals Management Service and was attended by over 200 persons. Environmental sensitivity and its relationship to OCS decision-making was the theme of the Sixth ITM. The first day was devoted to Pacific Region Program and technical overviews of the offices of Resource Evaluation, Leasing and Environment, and Field Operations followed by an open discussion. The second day included: (1) speakers from the U.S. Department of the Interior, industry, environmental groups, government and county representative, and academia; and (2) an open forum. The third day saw technical experts speak on studies involving the Santa Barbara Channel and Santa Maria Basin followed by an open discussion. GRA

N93-21695# Office of Science and Technology, Washington, DC.
US GLOBAL CHANGE DATA AND INFORMATION MANAGEMENT PROGRAM PLAN: A REPORT BY THE COMMITTEE ON EARTH AND ENVIRONMENTAL SCIENCES
24 Aug. 1992 107 p
(PB93-101293) Avail: CASI HC A06/MF A02

The importance of the effective management of data and information on global change has been highlighted by the U.S. Global Change Research Program (USGCRP) as an area requiring special emphasis. The importance was underlined by the establishment last year of a set of seven U.S. policy statements for global change data management, which form a basis for the report. In addition, the report responds to the several studies and reviews of the critical program area by the National Academy of Sciences. The report not only provides the framework for the global change data and information management program but commits the participating agencies to work with each other, with academia, and with the international community in its implementation. It also describes the programs of the participating agencies and outlines the next steps to be taken in the program. GRA

N93-21696# Federal Coordinating Council for Science, Engineering and Technology, Washington, DC. Committee on Earth and Environmental Sciences.
ECONOMICS AND GLOBAL CHANGE: THE FY 1993 RESEARCH PROGRAM ON THE ECONOMICS OF GLOBAL CHANGE. A SUPPLEMENT TO THE US PRESIDENT'S FY 1993 BUDGET AND A COMPANION DOCUMENT TO OUT CHANGING PLANET
Jan. 1992 69 p
(PB93-101244) Avail: CASI HC A04/MF A01

The report identifies three critical thrust areas for Fiscal Year 1993: (1) global economic models for the analysis of global environmental change; (2) uncertainty and the value of information; and (3) the economic effects of global change. Each thrust area identified in the year's program fills a critical need as the authors consider policy responses to global change. Our Nation's environmental and economic well-being is integrally linked to the actions and well-being of the rest of the world. Improved economic models are essential to improve understanding of these links and to the ability of the United States to develop and negotiate effective and cost-effective global environmental strategies. Author (GRA)

N93-21784 Iowa Univ., Iowa City. Dept. of Geography.
INFORMATION INTEGRATION FOR ENVIRONMENTAL MONITORING AND ASSESSMENT: AN ANNOTATED BIBLIOGRAPHY
R. Rajagopal, U. Natarajan, and J. Wacker 1992 29 p Submitted for publication
(PB92-227461) Copyright Avail: Issuing Activity

Annual federal and state investments in the collection, storage, and maintenance of resource and environmental data are enormous (estimated in the range of a few to tens of billions of dollars). Despite these investments, the use of information from these databases for societal endpoints has been limited. Further research to evaluate the utility of large environmental databases in the analysis of selected scientific and regulatory questions therefore would be timely. The primary purpose of the paper is to provide an annotated review of selected literature on the topic of information integration in the context of environmental monitoring and assessment. Based on a review of this literature, significant scholarly contributions to this field have been identified as falling into the following four issue areas: institutional, resource/ecological, design, and technological. The publications are grouped, indexed, associated with keywords, and organized under these four major issue areas. GRA

N93-21790# National Center for Atmospheric Research, Boulder, CO. Atmospheric Chemistry Div.
OZONE AS A SINK FOR ATMOSPHERIC CARBON AEROSOLS Ph.D. Thesis- Colorado Univ., 1992
Sherry Lynn Stephens Oct. 1992 136 p Sponsored by National Science Foundation, Washington, D.C. Prepared in cooperation with Colorado Univ., Boulder
(PB93-118594; NCAR/CT-136) Avail: CASI HC A07/MF A02

Information necessary for examining the chemical removal of smoke from the atmosphere by ozone has been obtained. The kinetics, products and temperature dependence of the reaction were determined. Initially the rate of ozone loss on carbon was followed. Gaseous products were quantified. An oxygen molecule was detected for every ozone lost. Initial loss rate was greatest. Heating the surface following exposure liberated products and restored reactivity. The reaction of ozone with soot was examined following loss of soot at temperatures from 21 to 175 C. Treating four types of soot together the activation energy and the order with respect to ozone were 11 (+/-) kcal mol(exp -1) and 0.89 (+/-0.05), respectively. The reaction of ozone with acetylene smoke was the final method of examining the reaction. The change of smoke size distribution and ozone concentration were monitored while controlling the temperature; irreproducibly caused the study to be unsuccessful. GRA

N93-21791# Massachusetts Inst. of Tech., Cambridge. Marine Industry Collegium.
FIELD SCREENING FOR ENVIRONMENTAL POLLUTANTS: DEFINING USER INSTRUMENTATION NEEDS
Oct. 1992 18 p Workshop held in Cambridge, MA, 26-27 Oct. 1992 Sponsored by National Sea Grant Coll. Program, Silver Spring, MD
(Grant NA92AA-D-SG424)
(PB93-117885; MITSG-92-17; OPPORTUNITY BRIEF-61) Avail: CASI HC A03/MF A01

The contents are as follows: Solute Transport Measurements in the Vadose Zone; Application of Field Screening Methods for Expediting and Improving Underground Storage Tank (IUST) Site Assessments; Field Screening Applications for the Detection of Metals; Data Quality Objectives for Semi-Volatile Field Screening Techniques; Field Instrumental Uses and Needs of U.S. EPA; Field Analysis and Mobile Laboratory Configuration for Hazardous Waste; Problems, Both Reoccurring and Unique in the Collection of Field Data; A Portable Mass Spectrometer for Collecting Field Data; On-Site Detection of Organize Contaminants by Thermal Desorption Gas Chromatography/Mass Spectrometry; Turnable Laser, Fiber-Optic Spectroscopy System for Monitoring Fuel Contamination; Environmental Applications of Fiber-Optic Based Chemical Sensors; Biotechnology-Based Diagnostic Methods for Detection of Environmental Pollutants; Legal Implications and Data Confidentiality; Bibliography of Topical Papers; and Bibliographies of Presenters. GRA

N93-21800# National Oceanic and Atmospheric Administration, Boulder, CO. Climate Monitoring and Diagnostic Lab.
PROCEEDINGS OF THE INTERNATIONAL COADS WORKSHOP
Henry F. Diaz, Klaus Wolter, and Scott D. Woodruff Aug. 1992 270 p Workshop held in Boulder, CO, 13-15 Jan. 1992 Prepared in cooperation with Cooperative Inst. for Research in Environmental Science
(PB93-123552) Avail: CASI HC A12/MF A03

The volume constitutes the proceedings of an international workshop held 13-15 Jan. 1992, in Boulder, Colorado. The workshop was organized to provide a forum for user feedback and evaluation of the Comprehensive Ocean-Atmosphere Data Set (COADS), and to help guide future development of the data set. The COADS was assembled in the U.S. and is the most complete historical record of surface marine weather observations now available. The data set, composed primarily of worldwide international ship observations, presently covers the period 1854-1991, and therefore, it represents a critical resource for studies of long-term climate change. A compilation of scientific papers and technical material presented or contributed to the workshop is provided. A summary of the most salient findings presented at the workshop is given, together with a synthesis of key recommendations made to assist in updating and improving the data set. GRA

N93-21805# National Oceanic and Atmospheric Administration, Seattle, WA. Office of Ocean Resources Conservation and Assessment.

EVALUATION OF THE EXTENT AND MAGNITUDE OF BIOLOGICAL EFFECTS ASSOCIATED WITH CHEMICAL CONTAMINANTS IN SAN FRANCISCO BAY, CALIFORNIA

Edward R. Long and Raymond Markel Mar. 1992 111 p

(PB93-118495; NOAA-TM-NOS-ORCA-64) Avail: CASI HC A06/MF A02

The objective of the report was to assess the spatial extent and magnitude (severity) of measures of adverse biological effects associated with chemical contaminants in San Francisco Bay. Chemical contaminants potentially toxic to marine and estuarine organisms have been detected and quantified in the sediments and biota of San Francisco Bay. These chemicals have the potential to be harmful to valued marine resources of San Francisco Bay if they occur in sufficiently high concentrations and are bioavailable. The data from these different studies, collectively, provide substantial evidence that toxicant-related effects occur among at least some of the resident biota of the estuary. However, the available data preclude an identification of the spatial patterns in toxicant-associated effects with a high degree of spatial resolution. The data are from analyses of either highly mobile fish, transient water masses, or small numbers of samples. Substantially more data available from numerous sediment toxicity tests, if merged, could provide needed information on the spatial extent of toxicant-associated effects. The approach taken in the report was to assemble as much data as possible from different investigations to piece together an estimate of the extent and severity of effects. GRA

N93-21806# Environmental Protection Agency, Cincinnati, OH. Center for Environmental Research Information.

GEOGRAPHIC INDEX OF ENVIRONMENTAL ARTICLES 1990

R. R. Bowker Nov. 1991 83 p

(PB93-116184; EPA/600/9-91/040) Avail: CASI HC A05/MF A01

This index was produced in accordance with the Environmental Research Geographical Location Information Act, Public Law 101-617, enacted by the United States Congress on November 16, 1990. Compiled by the U.S. Environmental Protection Agency, it is intended as a quick reference for locating published articles relating to environmental issues for individual geographic locations. This publication contains an extensive but limited listing of articles from forty-five journals and five proceedings published during 1990. Individuals may use this resource to locate reference materials covering environmental issues and research relating to various geographical locations around the world. It may be useful in finding literature for such purposes as detecting trends in global or regional environmental quality, assisting the public in learning more about environmental issues in their own communities, or identifying other areas of environmental interest. Listings contained in this publication are organized in two ways. The first half of the index lists articles according to the geographic locations on their subject matter. The second half presents the same listings organized by the individual source documents in which they appear. GRA

N93-21811# Environmental Protection Agency, Washington, DC. Information Access Branch.

ACCESS EPA

1992 596 p Original contains color illustrations

(PB92-147438; EPA-220/B-92-014; ISBN-0-16-037989-X) Avail: CASI HC A25/MF A06; SOD HC

Access EPA is a directory of U.S. Environmental Protection Agency (EPA) and other public sector environmental information resources. First published in 1991, this is the second, revised edition of the directory. There is information for everyone interested in the environment: citizens, consumers, householders; scientists; federal, state, local, and tribal governments; business people; and students and researchers. Contact information and a description of services is given for each information resource. Each chapter begins with a brief introduction and table of contents. In some instances, supplementary material is provided at the end of the chapter. With the exception of chapter 7, State Environmental Libraries, each of the chapters describes EPA information. After the eight chapters of information contacts are the following reference tools: acronyms that appear throughout Access EPA; an index of library and information services by state; and a name/title/subject index. Author (GRA)

N93-21827# Northeastern Forest Experiment Station, Chicago, IL. Urban Forest Climate Project.

CHICAGO'S EVOLVING URBAN FOREST: AN INITIAL REPORT OF THE CHICAGO URBAN FOREST CLIMATE PROJECT

E. Gregory McPherson, David J. Nowak, Paul L. Sacamano, and Scott E. Prichard Apr. 1992 100 p Prepared in cooperation with Chicago, Illinois Dept. of Environment

(PB93-129815) Avail: CASI HC A05/MF A02; SOD HC

The Chicago Urban Forest Climate Project (CUFCP) was initiated to research questions regarding the role of urban vegetation in environmental management. Findings will assist urban forestry programs to enhance environmental quality, energy efficiency, and civic beauty across the United States. The CUFCP study area consists of three sectors: Chicago, Cook County (executive of chicago), and DuPage County. Together, these sectors cover nearly 1,300 square miles and contain about 6 million people. This initial report describes work completed during the first year of the three-year study, as well as plans for future research. To date, our research has been aimed at understanding the region's natural and cultural history, the evolution of its urban forest, and current policy, management, and environmental issues meriting urban forest research. GRA

N93-21834# Urban Consortium for Technology Initiatives. Energy Task Force.

TECHNICAL COMPARISON BETWEEN HYTHANE, GNG AND GASOLINE FUELED VEHICLES

May 1992 78 p Prepared in cooperation with Public Technology, Inc., Washington, DC, and City of Denver, CO

(Contract DE-FG02-90CE-27504)

(DE93-005608; DOE/CE-27504/2) Avail: CASI HC A05/MF A01

Progress on the 2-year Alternative Fuel project, scheduled to end early 1993, is presented. Hythane is 85 vol percent compressed natural gas (CNG) and 15 vol percent hydrogen; it has the potential to meet or exceed the California Ultra-Low Emission Vehicle (ULEV) standard. Three USA trucks (3/4 ton pickup) were operated on single fuel (unleaded gasoline, CNG, and Hythane) in Denver. Emission testing, fueling facility, hazard and operability study, and a framework for a national hythane strategy are included. DOE

N93-21850# Synthetic Fuels Service, Inc., Mountain View, CA.

SCREENING ANALYSIS OF CO2 UTILIZATION AND FIXATION

H. E. Johnson, S. A. Vejtasa, J. E. Pelline, F. E. Biasca, D. R. Simbeck, and R. L. Dickenson Aug. 1992 138 p

(Contract DE-AC01-88FE-61680)

(DE93-004313; DOE/FE-61680/H2) Avail: CASI HC A07/MF A02

The debate continues regarding the potential of global climate change as a result of increasing concentrations of greenhouse gases within the Earth's atmosphere. Carbon dioxide emissions account for about 55 percent of these gases (excluding water vapor). The increased atmospheric CO2 concentration is primarily attributed to combustion of fossil fuels in energy production and to deforestation. This screening analysis addresses the various traditional and potential advanced options for utilization and fixation of CO2, primarily from coal-fired electrical power generation. The results indicate that power production via coal gasification combined cycle is the most effective and least expensive means currently available for reducing CO2 emissions from coal-fired power generation. Advanced coal-fired fuel cells, which are currently available, may prove to be substantially less expensive control options if the technology meets research goals. The costs associated with pipeline transport of CO2 to disposal or utilization sites are also presented. An extensive examination of the potential for underground disposal of CO2 in geologic structures by investigating injection into gas and oil fields, salt domes, and other porous structures is presented. The most viable option considered for CO2 disposal is in abandoned natural gas reservoirs. DOE

N93-21946*# Max-Planck-Inst. fuer Meteorologie, Hamburg (Germany).

PINATUBO ERUPTION WINTER CLIMATE EFFECTS: MODEL VERSUS OBSERVATIONS

Hans-F. Graf, Ingo Kirchner, Ingrid Schult, and Alan Robock (Maryland Univ., College Park.) Oct. 1992 28 p

(Grants NAG5-1835; NSF ATM-89-20590; BMFT-07-KFT-86/2)

(NASA-CR-191955; NAS 1.26:191955) Avail: CASI HC A03/MF A01

Large volcanic eruptions, in addition to the well-known effect of producing

global cooling for a year or two, have been observed to produce shorter-term responses in the climate system involving non-linear dynamical processes. In this paper, we use the ECHAM2 general circulation model forced with stratospheric aerosols to test some of these ideas. Run in a perpetual-January mode, with tropical stratospheric heating from the volcanic aerosols typical of the 1982 El Chichon eruption or the 1991 Pinatubo eruption, we find a dynamical response with an increased polar night jet in the Northern Hemisphere (NH) and stronger zonal winds which extended down into the troposphere. The Azores High shifts northward with increased tropospheric westerlies at 60N and increased easterlies at 30N. Surface temperatures are higher both in northern Eurasia and North America, in agreement with observations for the NH winters or 1982-83 and 1991-92 as well as the winters following the other 10 largest volcanic eruptions since 1883. Author

N93-21965# EG and G Energy Measurements, Inc., Idaho Falls.
THE IMPACT OF ELECTRIC VEHICLES ON CO2 EMISSIONS
J. M. Bentley, P. Teagan, D. Walls, E. Balles, and T. Parish May 1992 103 p Prepared in cooperation with Little (Arthur D.), Inc., Cambridge, MA
(Contract DE-AC07-76ID-01570)
(DE93-003719; EGG-EP-10296) Avail: CASI HC A06/MF A02

A number of recent studies have examined the greenhouse gas emissions of various light duty vehicle alternatives in some detail. These studies have highlighted the extreme range of predicted net greenhouse gas emissions depending on scenarios for fuel types, vehicle and power generation efficiencies, the relative greenhouse contributions of emitted gases, and a number of uncertainties in fuel chain efficiencies. Despite the potential range of results, most studies have confirmed that electric vehicles generally have significant potential for reducing greenhouse gas emissions relative to gasoline and most alternative fuels under consideration. The results of a study is summarized which builds on previous efforts. A detailed analysis of internal combustion engine vehicle (ICEV), fuel cell vehicle (FCV), and electric vehicle (EV) technology and electric power generation technology is discussed. Most previous transportation greenhouse studies have focused on characterization of fuel chains that have relatively high efficiency (65-85 percent) when compared with power generation (30-40 percent) and vehicle driveline (13-16 percent) efficiencies. A direct comparison is made of EV's, FCV's with gasoline and dedicated alternative fuel, ICEV's using equivalent vehicle technology assumptions with careful attention to likely technology improvements in both types of vehicles. Consideration of fuel cell vehicles and associated hydrogen infrastructure is discussed. Extension of analyses for several decades to assess the prospects for EV's with a longer term prospective is addressed. DOE

N93-21975# University of Southern Mississippi, Bay Saint Louis.
DEVELOPMENT OF A MULTI-SENSOR IN SITU FIBER OPTIC FLUOROMETER
S. E. Lohrenz, V. L. Asper, M. J. Morris (Ocean Optics, Inc., Dunedin, FL.), and R. A. Walters (Ocean Optics, Inc., Dunedin, FL.) Dec. 1992 19 p
(Contract DE-FG02-92ER-61443)
(DE93-004646; DOE/ER-61443/1) Avail: CASI HC A03/MF A01

Objective is to develop and evaluate a multi-sensor in situ fiber optic fluorometer. The instrument is designed to sample and store in vivo strobe-stimulated fluorescence data at multiple depths and high frequencies (1 Hz). This information may be used for estimating the distribution and abundance of particulate pigment biomass, for supporting models of water column primary production and as a complement to remotely sensed ocean color estimates of pigment biomass. The instrument is unique in that it uses fiber optic technology to increase vertical resolution. While it is theoretically possible to accomplish this task using a large number of commercially available fluorometers, our proposed design would provide a less expensive approach. A laboratory prototype has been built and is being tested. Preliminary results indicate that the instrument meets all the project goals and that low cost, high frequency, high spatial resolution chlorophyll data are obtainable with the current design. Further work is required to develop the seagoing version, and optimize the configuration of the fiber sensors. DOE

N93-21570# Commonwealth Scientific and Industrial Research Organization, Alice Springs (Australia). Wildlife and Ecology Div.
GLOBAL MODELS OF ECOSYSTEM CHANGE Status Report
B. H. Walker *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 3-7 (For primary document see N93-21569 07-42)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-21572# National Environmental Research Council, Reading (England). Remote Sensing Applications Development Unit.
EARTH OBSERVATION IN THE TIGER PROGRAMME OF THE UK NATURAL ENVIRONMENT RESEARCH COUNCIL
S. A. Briggs *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 13-17 (For primary document see N93-21569 07-42)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-21573# Joint Research Centre of the European Communities, Ispra (Italy). Remote Sensing Applications Inst.
PREPARATION OF AVHRR GAC DATA SETS FOR GLOBAL CHANGE STUDIES
A. S. Belward, J. V. Vogt, A. Falk-Langemann (Gesellschaft fuer Angewandte Fernerkundung, Munich, Germany.), S. Saradeth (Gesellschaft fuer Angewandte Fernerkundung, Munich, Germany.), and H. Cambridge (Serco Space Ltd., Sudbury-on-Thames, England.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 19-23 (For primary document see N93-21569 07-42)
Copyright Avail: CASI HC A01/MF A04

N93-21579# Academy of Sciences (USSR), Moscow. Scientific Research Center of Ecological Safety.
KEY PROBLEMS OF GLOBAL ECOLOGY AND THE INTERNATIONAL SPACE YEAR
K. Y. Kondratyev *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 55-56 (For primary document see N93-21569 07-42)
Copyright Avail: CASI HC A01/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-21602# Mullard Space Science Lab., Dorking (England).
LAKE REMOTE SENSING FOR GLOBAL CLIMATE RESEARCH
A. R. Harris, I. M. Mason, C. M. Birkett, and J. A. D. Mansley *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 173-178 (For primary document see N93-21569 07-42)
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N93-19985# Massachusetts Univ., Lowell. Center for Atmospheric Research.
THE MID-LATITUDE TROUGH. A REVIEW Report No. 2
James L. Scali Apr. 1992 76 p
(Contract F19628-90-K-0005)
(AD-A258606; AD-E201240; PL-TR-92-2100) Avail: CASI HC A05/MF A01

The mid-latitude trough is a depletion of F-region electron densities at sub-auroral latitudes which are mostly seen as a nocturnal feature usually

located between invariant latitudes 55 and 75 degrees. In this report, a review of past literature outlining the characteristics of the mid-latitude trough is presented. The material presented here will form the basis of further research in this field. In addition, procedures adopted for this research are discussed as a guide to the type of data analysis being undertaken.
GRA

N93-20003# Stanford Univ., CA. Environmental Fluid Mechanics Lab.
MULTIRESOLUTION FEATURE ANALYSIS AND WAVELET DECOMPOSITION OF ATMOSPHERIC FLOWS Final Technical Report, 1 Apr. 1989 - 30 Sep. 1991
Francis L. Ludwig, James C. Cross, III, and Robert L. Street Dec. 1992 15 p
(Contract N00014-89-J-1794)
(AD-A259420; SU-EFML-92-1) Avail: CASI HC A03/MF A01

This is the final technical report on application of fractal concepts to the analysis of atmospheric processes for the period from 1 Apr. - 30 Sep. 1991. The goal of the research was to improve understanding of atmospheric processes through the application of analytical approaches derived from the methods that have been associated with fractal and wavelet methods. This was the first phase of ongoing work that is now supported by a new grant for the period to 30 Sep. 1994. There were two major thrusts of this work to date. First, multiresolution feature analysis was applied to an atmospheric data set. In the process the analysis was extended to three-dimensional vector fields. To make the three-dimensional vector features imaginable, a variant of the Lorenz concept of empirical orthogonal function or EOF was adopted. These allow representation of empirically-defined patterns of small-scale atmospheric motions. Second, a strategy for the generalized wavelet analysis of homogeneous turbulence was developed. The strategy calls for decomposition of a collection of direct numerical simulation data sets for homogeneous turbulence in a stratified Boussinesq fluid subject to an imposed shear, in both two and three dimensions.
GRA

N93-20032# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
PARTICLE SIMULATION OF AURORAL DOUBLE LAYERS Ph.D. Thesis
Bruce L. Smith Jun. 1992 170 p
(AD-A258577; AFIT/CI/CIA-92-022D) Avail: CASI HC A08/MF A02

Externally driven magnetic reconnection has been proposed as a possible mechanism for production of auroral electrons during magnetic substorms. Fluid simulations of magnetic reconnection lead to strong plasma flows towards the increasing magnetic field of the earth. These plasma flows must generate large scale potential drops to preserve global charge neutrality. We have examined currentless injection of plasma along a dipole magnetic field into a bounded region using both analytic techniques and particle simulation.
GRA

N93-20053# Air Force Office of Scientific Research, Bolling AFB, Washington, DC.
CRUSTAL DEFORMATION MEASUREMENTS IN THE VICINITY OF VANDENBERG AIR FORCE BASE Annual Technical Report, 1 Jan. 1991 - 30 Sep. 1992
Robert W. King 1 Dec. 1992 5 p
(Grant AF-AFOSR-0400-89)
(AD-A258536; AFOSR-92-1030TR) Avail: CASI HC A01/MF A01

Recent geological and geodetic studies have suggested that the region surrounding Vandenberg AFB is undergoing active crustal deformation, with important implications for both the geodetic stability and the seismogenic potential of the Western Test Range (WTR). Part of the evidence for significant deformation was obtained from Global Positioning System (GPS) measurements which were carried out in cooperation with other university and government scientists beginning in 1986. These measurements were made annually over a broad region of central and southern California but are of insufficient spatial and temporal density to answer many questions about the seismogenic potential of Vandenberg. In March 1992, the relative positions of the Vandenberg network stations occupied in our experiments of February and September 1990 were remeasured, and nine new stations to densify the network were established. The Vandenberg PGGA station has been acquiring data almost continuously since 22 May 1992, and provided an important anchor site for measuring far-field displacements from the Landers (M(sub W)7.3) and Big Bear (M(sub W)6.2) earthquakes of 28 June.
GRA

N93-20066*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
A NEW SOFTWARE TOOL FOR COMPUTING EARTH'S ATMOSPHERIC TRANSMISSION OF NEAR- AND FAR-INFRARED RADIATION
Steven D. Lord Dec. 1992 194 p
(RTOP 352-03-03-02)
(NASA-TM-103957; A-92154; NAS 1.15:103957) Avail: CASI HC A09/MF A03

This report describes a new software tool, ATRAN, which computes the transmittance of Earth's atmosphere at near- and far-infrared wavelengths. We compare the capabilities of this program with others currently available and demonstrate its utility for observational data calibration and reduction. The program employs current water-vapor and ozone models to produce fast and accurate transmittance spectra for wavelengths ranging from 0.8 microns to 10 mm.
Author

N93-20238*# Smithsonian Astrophysical Observatory, Cambridge, MA.
MEASUREMENT AND INTERPRETATION OF CRUSTAL DEFORMATION RATES ASSOCIATED WITH POSTGLACIAL REBOUND Semiannual Status Report No. 2, 15 Sep. 1992 - 14 Mar. 1993
James L. Davis Feb. 1993 32 p
(Contract NAG5-1930)
(NASA-CR-192245; NAS 1.26:192245) Avail: CASI HC A03/MF A01

This project involves obtaining Global Positioning System (GPS) measurements in Scandinavia, and using the measurements to estimate the viscosity profile of the Earth's mantle and to correct tide-gage measurements for the rebound effect. Several aspects of this project are reported.
Author (revised)

N93-20248*# Colorado State Univ., Fort Collins. Cooperative Inst. for Research in the Atmosphere.
GEOSTATIONARY EARTH CLIMATE SENSOR: SCIENTIFIC UTILITY AND FEASIBILITY, PHASE A Final Report
G. Garrett Campbell, T. H. VonderHarr, T. Evert (TRW, Inc., Colorado Springs, CO.), Stanley Q. Kidder, and James F. W. Purdom Jul. 1991 93 p Original contains color illustrations
(Grant NAG8-145)
(NASA-CR-191919; NAS 1.26:191919) Avail: CASI HC A05/MF A01; 1 functional color page

The possibility of accurate broad band radiation budget measurements from a GEO platform will provide a unique opportunity for viewing radiation processes in the atmosphere-ocean system. The CSU/TRW team has prepared a Phase 1 instrument design study demonstrating that measurements of radiation budget are practical from geosynchronous orbit with proven technology. This instrument concept is the Geostationary Earth Climate Sensor (GECS). A range of resolutions down to 20 km at the top of the atmosphere are possible, depending upon the scientific goals of the experiment. These tradeoffs of resolution and measurement repeat cycles are examined for scientific utility. The design of a flexible instrument is shown to be possible to meet the two goals: long-term, systematic monitoring of the diurnal cycles of radiation budget; and high time and space resolution studies of regional radiation features.
Author

N93-20250*# Rice Univ., Houston, TX. Center for Space Physics.
MAGNETOSPHERIC AND AURORAL PROCESSES Semiannual Progress Report, 1 Mar. - 31 Aug. 1990
Patricia H. Reiff 31 Aug. 1990 4 p
(Grant NAGw-1655)
(NASA-CR-192138; NAS 1.26:192138) Avail: CASI HC A01/MF A01

Progress was made on the following two projects within the semiannual period: (1) simulations of the magnetic storm of April 1988 using the Magnetospheric Specification Model; and (2) improvement of a user-oriented electric-field model.
Author

N93-20279 Miami Univ., Coral Gables, FL.
AN INVESTIGATION OF LOW-FREQUENCY PLANETARY WAVE FORCING AND PREDICTABILITY IN A SIMPLE GLOBAL ATMOSPHERIC CIRCULATION MODEL Ph.D. Thesis
Douglas A. Stewart 1992 339 p
Avail: Univ. Microfilms Order No. DA9239667

Dynamically consistent data generated by a simple 2-level global spectral model are used in conjunction with a diagnostic method to study the

forcing of large-scale low-frequency (LF) atmospheric fluctuations. Run in perpetual January mode at moderate spatial resolution (i.e., R15 truncation), the model realistically simulates pertinent features of the observed time-mean climate and variability. The diagnostic method consists of calculating, from the R15 model output, the terms of the governing equations of a hypothetical low-order model that simulates only the slowly-evolving planetary-scale flow. The right hand sides of these low-pass-filtered equations are expressed in terms of resolved forcing and unresolved forcing, with the former representing autonomous processes involving only the large-scale LF components of the flow, and the latter containing the effects of high-frequency (HF) transient eddies. The roles of resolved and unresolved forcing during the various stages of composite positive and negative persistent anomalies are assessed. During anomaly maintenance, HF transient eddies anchor anomalies against downstream propagation and resist local decay. In contrast, the thermal forcing of the HF eddies acts in a destructive sense. Applying the diagnostic method to the onset stage suggests that autonomous processes typically determine the local growth of both positive and negative anomalies, consistent with interpreting their origin as a large-scale instability. The development of anomalies in HF transient eddy forcing, in general, stem from the evolution of the large-scale flow, rather than acting independently to initiate the large-scale anomaly development. A low-order model is constructed to simulate the dynamics of slowly-evolving planetary-scale flow. Relationships between the resolved and unresolved forcing gleaned from the diagnostic phase of the study are exploited in the development of a quasi-stochastic parameterization of the latter in terms of the former. The skill of the low-order model is tested against the low-pass-filtered output from the R15 model by performing a series of Monte Carlo experiments. The low-order model produces skillful forecasts out to ten days. RMS errors in the upper layer streamfunction predictions grow most rapidly in the storm track regions, and are correlated most strongly with the HF transient kinetic energy patterns. Dissert. Abstr.

N93-20283 Cornell Univ., Ithaca, NY.
ELECTRON ACCELERATION IN THE MAGNETOSPHERE Ph.D. Thesis
Cho Hoi Hui 1992 165 p
Avail: Univ. Microfilms Order No. DA9300833

The mechanisms of auroral electron acceleration are studied by two particle simulation modles. The first model is a two-dimensional hybrid-kinetic description used to study the self consistent electron kinetics of Alfven waves on the electron inertial scale. The ions are assumed to follow a fluid description and the parallel electron motion is treated kinetically using particle-in-cell techniques. In this model the electron plasma mode is eliminated and only the physics of the Alfven waves is retained. For a cold plasma, it is found that oblique Alfven waves break due to finite electron inertia. The consequence of wave breaking is the formation of an electron beam which can be unstable to the beam-plasma instability. The electrons supporting the parallel current thermalize into a non-Maxwellian distribution with an energetic tail up to several keV, assuming a reasonable magnetospheric Alfven speed. In hot plasma simulations, electron trapping is the principal mechanism of electron acceleration. It is proposed that wave breaking or electron trapping of oblique Alfven waves at 1 R(sub E) can result in electron acceleration and may explain some observed auroral phenomena. The second model is a two-dimensional high frequency magnetized electron plasma particle code, which is used to investigate the parametric coupling of electromagnetic modes to the upper-hybrid and electrostatic whistler modes. A large amplitude X-mode generated by auroral kilometric radiation is shown to excite the electrostatic whistler wave and Z-mode by a parametric instability. The parallel electric field of the electrostatic whistler wave can cause the wave to break and pitch angle scatter electrons into the loss cone. This may account for the electron precipitation of diffuse aurora. Dissert. Abstr.

N93-20295*# Augsburg Coll., Minneapolis, MN.
A CORRELATIVE INVESTIGATION OF THE PROPAGATION OF ULF WAVE POWER THROUGH THE DAYSIDE MAGNETOSPHERE Status Report, 1 Jul. - 31 Dec. 1991
Mark J. Engebretson 31 Dec. 1991 11 p
(Grant NAGw-1567)
(NASA-CR-192141; NAS 1.26:192141) Avail: CASI HC A03/MF A01

During the reporting period 1 Jul. - 31 Dec. 1991, work continued in each of the major areas of study proposed for this project: analysis of radially polarized pulsations; impulse event studies; and radial boundaries of Pc 3-4 pulsations in the dayside magnetosphere. Author

N93-20302*# Rhode Island Univ., Narragansett. Graduate School of Oceanography.
SULFUR MASS LOADING OF THE ATMOSPHERE FROM VOLCANIC ERUPTIONS: CALIBRATION OF THE ICE CORE RECORD ON BASIS OF SULFATE AEROSOL DEPOSITION IN POLAR REGIONS FROM THE 1982 EL CHICHON ERUPTION Semiannual Progress Report
Haraldur Sigurdsson and Paolo Laj 6 Sep. 1990 11 p
(Grant NAG5-1304)
(NASA-CR-192409; NAS 1.26:192409) Avail: CASI HC A03/MF A01

Major volcanic eruptions disperse large quantities of sulfur compound throughout the Earth's atmosphere. The sulfuric acid aerosols resulting from such eruptions are scavenged by snow within the polar regions and appear in polar ice cores as elevated acidity layers. Glacio-chemical studies of ice cores can, thus, provide a record of past volcanism, as well as the means for understanding the fate of volcanic sulfur in the atmosphere. The primary objectives of this project are to study the chemistry and physical properties of volcanic fallout in a Greenland Ice Core in order to evaluate the impact of the volcanic gases on the atmospheric chemistry and the total atmospheric mass of volcanic aerosols emitted by major volcanic eruptions. We propose to compare the ice core record to other atmospheric records performed during the last 10 years to investigate transport and deposition of volcanic materials. Author

N93-20310*# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric, and Planetary Sciences.
LITHOSPHERIC DYNAMICS NEAR PLATE BOUNDARIES Semiannual Status Report, 15 Mar. - 14 Sep. 1992
Sean C. Solomon 14 Sep. 1992 172 p
(Grant NAG5-1921)
(NASA-CR-192108; NAS 1.26:192108) Avail: CASI HC A08/MF A02

The progress report on research conducted between 15 Mar. - 14 Sep. 1992 is presented. The focus of the research during the first grant year has been on several problems broadly related to the nature and dynamics of time-dependent deformation and stress along major seismic zones, with an emphasis on western North America but with additional work on seismic zones in oceanic lithosphere as well. The principal findings of our research to date are described in the accompanying papers and abstract. Topics covered include: (1) Global Positioning System measurements of deformations associated with the 1987 Superstition Hills earthquake: evidence for conjugate faulting; (2) Global Positioning System measurements of strain accumulation across the Imperial Valley, California: 1986-1989; (3) present-day crustal deformation in the Salton Trough, southern California; (4) oceanic transform earthquakes with unusual mechanisms or locations: relation to fault geometry and state of stress in the lithosphere; and (5) crustal strain and the 1992 Mojave Desert earthquakes. Author

N93-20359# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
EQUATORIAL F-REGION ELECTRON DENSITIES OVER A SOLAR CYCLE: COMPARISONS BETWEEN OBSERVATIONS AND NUMERICAL MODELS M.S. Thesis
Amanda P. Creamer 1992 221 p
(AD-A258572; AFIT/CI/CIA-92-079) Avail: CASI HC A10/MF A03

Incoherent scatter radar observations at Jicamarca, Peru, from 1964 to the present, are used to study the seasonal and solar cycle variations in the daily equatorial ionospheric plasma density profiles for select hours. The peak density, peak layer heights, and layer thickness are dependent on solar activity which is determined by F10.7 cm flux. There are large variations in the daily plasma density profiles for each season and solar flux. The peak plasma densities are largest for December solstice (southern hemisphere summer), and smallest for June solstice (southern hemisphere winter). The changes in the peak height, bottomside density, and topside density are dependent on seasonal and on temporal variations in the equatorial F-region vertical plasma drifts at Jicamarca. Geomagnetic disturbance affects primarily the topside F-region density layer. The average quiet-time seasonal profiles were compared with the International Reference Ionosphere (IRI), the Fully Analytic Ionospheric Model (FAIM), and the Parameterized Real-time Ionospheric Specification Model (PRISM) for similar time, season, and solar activity. The IRI is particularly good at representing the peak density for all seasons and all levels of solar activity; however,

the model does not reproduce well the observed variations of the peak heights and layer thickness with season and solar flux. FAIM gives a good estimate of the peak density during winter and equinox, and a rate of increase in peak layer height with flux comparable to the data for all seasons. The FAIM layer thickness fits to the data are better than those of the IRI. However, they do not reproduce the data for high solar activity. PRISM gives a good fit to the data for all parameters except day and evening topside profiles. The layer thickness calculated from this model also gives the best representation of the experiment results. Author

N93-20363# Aerospace Corp., El Segundo, CA. Engineering and Technology Group.
FORMATION OF AURORAL ARCS VIA MAGNETOSPHERE-IONOSPHERE COUPLING
L. R. Lyons 15 Sep. 1992 24 p
(Grant NSF ATM-88-00602)
(AD-A258641; ATR-91(7186)-2) Avail: CASI HC A03/MF A01

Brilliant displays of light are visible within a polar band of latitudes that surround each of the Earth's geomagnetic poles. These emissions are known as the aurora, and they are a dramatic consequence of the electromagnetic interaction between the Sun and the Earth. Energy is carried from the Sun by the plasma of the solar wind. This plasma impinges upon the magnetic field of the Earth and powers a wide range of electrodynamical phenomena that include the aurora. The aurora itself results from electrons that first are energized at very high altitudes by the solar wind-Earth interactions and then travel down magnetic field lines until they hit the atmosphere. In this tutorial 1 discuss the basic physical processes that lead to the energization of these electrons and thus to the aurora. GRA

N93-20378# Massachusetts Univ., Lowell. Center for Atmospheric Research.
OBSERVATION OF IONOSPHERIC MODIFICATION USING HIGH POWER OBLIQUE HF TRANSMISSIONS Report No. 1
Gary S. Sales and Yuming Huang Jun. 1992 38 p
(Contract F19628-90-K-0039)
(AD-A258706; AD-E201239; PL-TR-92-2079) Avail: CASI HC A03/MF A01

A series of experiments were carried out during late May 1991 to investigate changes produced in the ionosphere by a high power HF transmitter operating at a frequency approximately two times the F-layer critical frequency. These high power oblique transmissions heated a region of the ionosphere some 1200km east of the Delano, CA Voice of America relay station, operating with an effective radiated power of 90 dBW. An HF probe signal was used to detect changes in the ionosphere as it passed through the modified region. The probe system, operating at a frequency very close to the heater frequency, frequently showed amplitude changes that correlate well with the ten minute on/off cycling of the high power transmitter. This preliminary study used several signal processing methods to detect these changes in the presence of strong polarization fading. The results indicate that the amplitude of the probe signal decreased by 2 to 3 dB, often within 15 to 30s after the high power transmitter was turned on. GRA

N93-20379# McDonnell-Douglas Astronautics Co., Huntington Beach, CA.
IMPROVED MODELS OF THE INNER AND OUTER RADIATION BELTS Report No. 2
K. A. Pfitzer Aug. 1992 56 p
(Contract F19628-90-C-0099)
(AD-A258708; AD-E201292; PL-TR-92-2193) Avail: CASI HC A04/MF A01

In March 1991, after a very sudden commencement, the CRRES satellite observed the creation of a large flux of high energy protons and electrons in the inner magnetosphere. A vector potential model of the time dependent Chapman-Ferraro currents is developed for this sudden commencement. This time dependent vector potential is then used to determine the magnetic field and the induction electric field during the sudden commencement. The model magnetic signature agrees well with the CRRES observations. The induction electric field calculated by the model ranges from 10s of milliVolts per meter at 3 Re on midnight side of the earth to as large as 400 milliVolts per meter on the noon meridian. The electric field is non-conservative and is capable of accelerating protons and electrons to many 10s of MeV. Sample proton trajectories are used to determine the acceleration of particles in the storm-time magnetic and electric fields. The appendix lists the complete FORTRAN code of the time dependent magnetic and electric field models. GRA

N93-20381# New England Research, Inc., White River Junction, VT.
ELASTIC MODULI AND SEISMIC WAVE ATTENUATION IN DRY AND SATURATED ROCK. VOLUME 2: MODULUS DISPERSION AND ATTENUATION Final Report, 15 May 1989 - 31 Dec. 1991
Robert W. Haupt, Randolph J. Martin, III, Xiao M. Tang, and William Dupree 31 Jul. 1992 92 p
(Contract F19628-89-C-0097)
(AD-A258711; AD-E201293; PL-TR-92-2199-Vol-2) Avail: CASI HC A05/MF A01

Four different laboratory techniques were used to determine Young's modulus and extensional wave attenuation as a function of frequency for the same rock specimen while minimizing variations in other important parameters. The data were then pieced together and compared over a net frequency bandwidth ranging from .01 to 1,000,000 Hz. Specimens of Sierra White granite and Berea sandstone were analyzed in dry and water saturated states. Dispersion in moduli and attenuation in the dry samples are negligible. Frequency dependent attenuation and modulus dispersion are clearly evident in the saturated samples and attributed to flow of pore fluid, unconfined sample boundaries and sample dimensions. A cyclic loading technique was used to examine the effects of strain amplitude and water saturation at constant frequency. The modulus and attenuation determined from hysteresis loops are strain amplitude dependent in both dry and saturated states. As strain amplitudes are increased above 5 x .000001, the modulus continually drops while attenuation increases. A significant reduction in modulus is observed in the saturated samples that is attributed to a reduction in surface energy at the fluid/rock interface and an unconfined sample radial boundary. GRA

N93-20755*# Arizona Univ., Tucson.
A STUDY OF THE LARGE-SCALE INFRARED EMISSION FROM A SELECTED DARK CLOUD Final Technical Report, 15 Aug. 1989 - 14 Sep. 1990
Erick T. Young 16 Feb. 1993 6 p
(Grant NAG5-1221)
(NASA-CR-192263; NAS 1.26:192263) Avail: CASI HC A02/MF A01

An investigation of the infrared emission energetics and embedded population in the rho Ophiuchi dark cloud is summarized. With a distance of approximately 140 pc, the rho Ophiuchi cloud is one of the closest regions of recent star formation. It is also one of the best studied such regions with numerous observations at all wavelengths. The Infrared Astronomy Satellite (IRAS) data of the cloud provided a new glimpse of the overall structure of the cloud. In particular, the interaction of radiation from the Sco-Oph OB Association on the external heating of the cloud was very evident on Skyflux and Survey CO-Add images produced by IRAS. The infrared survey also revealed a number of new embedded sources in the cloud which have subsequently been observed from the ground. In earlier study, the overall energies of the cloud using the IRAS data was explored. The main conclusions of that work were: (1) the overall luminosity of the cloud is well explained by the emission of the known B-stars, HD 147889, SR-3, and S1, along with a 15 percent contribution from the external radiation field; (2) the dust physical temperatures were significantly lower than the observed CO gas temperatures; and (3) dust grains are heated to only 10 percent to 20 percent of the total depth into the cloud. This analysis was extended by drawing on data from large-scale CO maps of Loren (1989) and from near-infrared surveys of the embedded population. Author (revised)

N93-20758*# Michigan Univ., Ann Arbor. Space Physics Research Lab.
THE EFFECTS ON THE IONOSPHERE OF INERTIA IN THE HIGH LATITUDE NEUTRAL THERMOSPHERE Final Report, Apr. 1989 - Apr. 1993
Alan Burns and Timothy Killeen 15 Feb. 1993 8 p
(Grant NAGw-1535)
(NASA-CR-192358; NAS 1.26:192358) Avail: CASI HC A02/MF A01

High-latitude ionospheric currents, plasma temperatures, densities, and composition are all affected by the time-dependent response of the neutral

thermosphere to ion drag and Joule heating through a variety of complex feedback processes. These processes can best be studied numerically using the appropriate nonlinear numerical modeling techniques in conjunction with experimental case studies. In particular, the basic physics of these processes can be understood using a model, and these concepts can then be applied to more complex realistic situations by developing the appropriate simulations of real events. Finally, these model results can be compared with satellite-derived data from the thermosphere. We used numerical simulations from the National Center of Atmospheric Research Thermosphere/Ionosphere General Circulation Model (NCAR TIGCM) and data from the Dynamic Explorer 2 (DE 2) satellite to study the time-dependent effects of the inertia of the neutral thermosphere on ionospheric currents, plasma temperatures, densities, and composition. One particular case of these inertial effects is the so-called 'fly-wheel effect'. This effect occurs when the neutral gas, that has been spun-up by the large ionospheric winds associated with a geomagnetic storm, moves faster than the ions in the period after the end of the main phase of the storm. In these circumstances, the neutral gas can drag the ions along with them. It is this last effect, which is described in the next section, that we have studied under this grant. Derived from text

N93-20900*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

NASA SPACE GEODESY PROGRAM: GSFC DATA ANALYSIS, 1992. CRUSTAL DYNAMICS PROJECT VLBI GEODETIC RESULTS, 1979 - 1991 Final Report

J. W. Ryan, C. Ma, and D. S. Caprette (Hughes STX, Inc., Lanham, MD.) Feb. 1993 471 p

(NASA-TM-104572; Rept-93B00055; NAS 1.15:104572) Avail: CASI HC A20/MF A04

The Goddard VLBI group reports the results of analyzing 1648 Mark 3 data sets acquired from fixed and mobile observing sites through the end of 1991, and available to the Crustal Dynamics Project. Two large solutions were used to obtain Earth rotation parameters, nutation offsets, radio source positions, site positions, site velocities, and baseline evolution. Site positions are tabulated on a yearly basis for 1979 to 1995, inclusive. Site velocities are presented in both geocentric Cartesian and topocentric coordinates. Baseline evolution is plotted for 200 baselines, and individual length determinations are presented for an additional 356 baselines. This report includes 155 quasar radio sources, 96 fixed stations and mobile sites, and 556 baselines. Author

N93-20951# Rome Univ. (Italy). Dipt. di Fisica.

GRAVITATIONAL SYNCHROTRON RADIATION AND GRAVITRONS BY LIGHTS

Daniele Fargion (Technion - Israel Inst. of Tech., Haifa.) 13 Sep. 1991 17 p Submitted for publication

(Preprint-821; ETN-93-92926) Avail: CASI HC A03/MF A01

The differential gravitational synchrotron radiation power emitted by a bunch of rotating charges is derived. The 'local' and 'resonant' emissions are evaluated. Nonrelativistic and ultrarelativistic limits are discussed. Bunches of photons in dissipationless toroidal fiber optics are found as the best sources of gravitational waves. A holographic array, the hologravers, made up of small coherent fiber optic rings, allows focalizing in a wavelength radius of almost all the gravitational waves power reaching the largest available artificial gravitational waves flux and metric deviations. For a storaged energy E in all the hologravers, the flux and metric deviation are obtained. ESA

N93-21225# Oak Ridge National Lab., TN.

COKRIGING SURFACE ELEVATION AND SEISMIC REFRACTION DATA FOR BEDROCK TOPOGRAPHY

J. E. Nyquist, W. E. Doll, R. K. Davis, and R. A. Hopkins (Marrich, Inc., Knoxville, TN.) 1992 14 p Presented at the Symposium on Application of Geophysics to Engineering and Environmental Problems, Oakbrook, IL, 26-29 Apr. 1992

(Contract DE-AC05-84OR-21400)

(DE93-001369; CONF-9204205-1) Avail: CASI HC A03/MF A01

Analysis of seismic refraction data collected at a proposed site of the Advanced Neutron Source (ANS) Facility showed a strong correlation between surface and bedrock topography. By combining seismically determined bedrock elevation data with surface elevation data using cokriging, we were able to significantly improve our map of bedrock topography without collecting additional seismic data. DOE

N93-21253# New England Research, Inc., White River Junction, VT.

THE SENSITIVITY OF SEISMIC RESPONSES TO GAS HYDRATES

J. E. Foley and D. R. Burns Aug. 1992 24 p

(Contract DE-FG21-91MC-28079)

(DE93-000216; DOE/MC-28079/3131) Avail: CASI HC A03/MF A01

The sensitivity of seismic reflection coefficients and amplitudes, and their variations with changing incidence angles and offsets, was determined with respect to changes in the parameters which characterize marine sediments containing gas hydrates. Using the results of studies of ice saturation effects in permafrost soils, we have introduced rheological effects of hydrate saturation. The replacement of pore fluids in highly porous and unconsolidated marine sediments with crystalline gas hydrates, increases the rigidity of the sediments, and alters the ratio of compressional/shear strength ratio. This causes Vp/Vs ratio variations which have an effect on the amplitudes of P-wave and S-wave reflections. Analysis of reflection coefficient functions has revealed that amplitudes are very sensitive to porosity estimates, and errors in the assumed model porosity can effect the estimates of hydrate saturation. Additionally, we see that the level of free gas saturation is difficult to determine. A review of the effects of free gas and hydrate saturation on shear wave arrivals indicates that far-offset P to S wave converted arrivals may provide a means of characterizing hydrate saturations. Complications in reflection coefficient and amplitude modelling can arise from gradients in hydrate saturation levels and from rough sea floor topography. An increase in hydrate saturation with depth in marine sediments causes rays to bend towards horizontal and increases the reflection incidence angles and subsequent amplitudes. This effect is strongly accentuated when the vertical separation between the source and the hydrate reflection horizon is reduced. The effect on amplitude variations with offset due to a rough sea floor was determined through finite difference wavefield modelling. Strong diffractions in the waveforms add noise to the amplitude versus offset functions. DOE

N93-21364*# Southwest Research Inst., San Antonio, TX. Instrumentation and Space Research Div.

STUDIES OF INTERACTIVE PLASMA PROCESSES IN THE POLAR CUSP Semiannual Report

J. Hunter Waite, Jr. 28 Feb. 1992 27 p

(Grant NAGw-1657)

(NASA-CR-192137; NAS 1.26:192137; SwRI Proj. 15-2783) Avail: CASI HC A03/MF A01

Progress during the reporting period is presented. Several distinctly different areas of research are presently being pursued: (1) studies of the thermal structure of polar outflows; (2) Prognoz data analysis; and (3) Ulysses Jupiter encounter. L.R.R.

N93-21374*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

NASA SPACE GEODESY PROGRAM: CATALOGUE OF SITE INFORMATION

M. A. Bryant (McDonnell-Douglas Space Systems Co., Seabrook,MD.) and C. E. Noll Washington Mar. 1993 688 p

(NASA-TM-4482; Rept-93B00058; NAS 1.15:4482) Avail: CASI HC A99/MF A06

This is the first edition of the NASA Space Geodesy Program: Catalogue of Site Information. This catalogue supersedes all previous versions of the Crustal Dynamics Project: Catalogue of Site Information, last published in May 1989. This document is prepared under the direction of the Space Geodesy and Altimetry Projects Office (SGAPO), Code 920.1, Goddard Space Flight Center. SGAPO has assumed the responsibilities of the Crustal Dynamics Project, which officially ended December 31, 1991. The catalog contains information on all NASA supported sites as well as sites from cooperating international partners. This catalog is designed to provde descriptions and occupation histories of high-accuracy geodetic measuring sites employing space-related techniques. The emphasis of the catalog has been in the past, and continues to be with this edition, station information for facilities and remote locations utilizing the Satellite Laser Ranging (SLR), Lunar Laser Ranging (LLR), and Very Long Baseline Interferometry (VLBI) techniques. With the proliferation of high-quality Global Positioning System

(GPS) receivers and Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS) transponders, many co-located at established SLR and VLBI observatories, the requirement for accurate station and localized survey information for an ever broadening base of scientists and engineers has been recognized. It is our objective to provide accurate station information to scientific groups interested in these facilities. Author

N93-21547# National Center for Atmospheric Research, Boulder, CO.
NATIONAL CENTER FOR ATMOSPHERIC RESEARCH, FISCAL YEAR 1991 Annual Report, 1 Oct. 1990 - 30 Sep. 1991
Lucy Warner, ed. Jun. 1992 62 p Sponsored by National Science Foundation, Washington, DC
(PB93-129914) Avail: CASI HC A04/MF A01

The National Center for Atmospheric Research (NCAR) annual report for fiscal year 1991 is presented. NCAR's projects for the period included investigations of air pollution from the oil well fires in Kuwait, a solar eclipse, thunderstorms in central Florida, the El Nino current, greenhouse processes, and upper atmosphere phenomena. GRA

N93-21686# International Geophysical Year World Data Center A, Boulder, CO.
GLOBAL CHANGE DATA BASE PILOT (DISKETTE) PROJECT FOR AFRICA. DASE BASE DOCUMENTATION VERSION 1.1
Jun. 1992 300 p Sponsored by National Geophysical Data Center, Boulder, CO
(PB93-117927; SE-47) Avail: CASI HC A13/MF A03

The data base for Africa contains vegetation data, climate data, and other thematic data for a recent three and a half year period. The documentation contains separate chapters of material edited about separate data sets of the overall Global Change Data Base, Pilot (diskette) Project for Africa. Descriptions of data formats, authors, and contributors are accompanied by documentation of the development/use of the data. These materials have been suggested and contributed directly by the authors of the individual data sets. To avoid confusion, some information contained in the documentation that is not directly relevant to the data base has been either omitted, crossed out, or blanked out. GRA

N93-21691# Geological Survey, Denver, CO.
NEWLY RECOGNIZED DUCTILE SHEAR ZONE IN THE NORTHERN KLAMATH MOUNTAINS, OREGON. IMPLICATIONS FOR NEVADAN ACCRETION
Mary M. Donato 1992 17 p
(PB93-115632; USGS/BULL-2028; LC-92-20834) Avail: CASI HC A03/MF A01

One of the most frequently encountered problems in structural analysis of complexly deformed metamorphic terranes is the determination of the sense of movement in sheared rocks. In regions composed of accreted terranes, such as the Klamath Mountains, such information can shed light on the relative motions of large blocks of crust and may enhance our understanding of the processes by which accretion takes place. This study uses mesoscopic structural data, petrographic criteria, and quartz petrofabric analysis to deduce the sense of shear in ductility deformed quart-zites and semi-pelitic schists from a newly discovered mylonitic shear zone separating the May Creek Schist and structurally underlying amphibolite in the northern-most Klamath Mountains. GRA

N93-21692# Geological Survey, Denver, CO.
GEOLOGY AND GEOCHEMISTRY OF EARLY PROTEROZOIC ROCKS IN THE DUNBAR AREA, NORTHEASTERN WISCONSIN
P. K. Sims, K. J. Schulz, and Z. E. Peterman 1992 74 p
(PB93-115640; USGS-PP-1517; LC-90-14105) Avail: CASI HC A04/MF A01

The main purpose of this study was to gain a better understanding of the geologic evolution of this part of the Wisconsin magmatic terranes and its relationship to the adjacent continental-margin assemblage in Michigan. As part of the study, we mapped in detailed reconnaissance fashion the Dunbar and Dunbar NE 7 1/2-minute quadrangles. Samples of representative rocks were collected from these areas as well as from previously mapped areas for petrographic and chemical studies and isotopic age determinations. This report describes the field relations, structure, geochemistry, and ages of major rock units in the Dunbar area. GRA

N93-21693# International Geophysical Year World Data Center A, Boulder, CO.
WORLD DATA CENTER A FOR SOLID EARTH GEOPHYSICS. CATALOG OF SIGNIFICANT EARTHQUAKES 2150 B.C.-1991 A.D. INCLUDING QUANTITATIVE CASUALTIES AND DAMAGE
Paula K. Dunbar, Patricia A. Lockridge, and Lowell S. Whiteside Sep. 1992 329 p Sponsored by National Geophysical Data Center, Boulder, CO
(PB93-118198; SE-49) Avail: CASI HC A15/MF A03

The catalog is a listing of historical earthquakes throughout the world that range in date from 2150 B.C. to 1991 A.D. The events were gathered from scientific and scholarly sources, regional and worldwide catalogs, and individual event reports. The list includes all events that meet at least one of the following criteria: moderate damage (approximately $1 million or more); ten or more deaths; magnitude 7.5 or greater; and intensity X or greater (for events lacking magnitude). GRA

N93-21700# Saint Louis Univ., MO. Dept. of Earth and Atmospheric Sciences.
ATTENUATION AND SOURCE STUDIES IN NORTHERN EURASIA Semiannual Technical Report, 9 Jan. - 8 Jul. 1992
Brian J. Mitchell and J. K. Xie 30 Dec. 1992 46 p
(Contract MIPR-FY3592-91-10651)
(AD-A259323) Avail: CASI HC A03/MF A01

A new inversion method, in which the frequency dependence of shear wave internal friction (Q(sub mu))(sup -1) is allowed to vary with depth, was developed and applied to selected Rayleigh wave attenuation data in the Basin and Range Province of the southwestern United States. Models were further constrained to satisfy observed values of Q and the frequency dependence of Lg waves in that region. Many models can explain those two data sets within their uncertainties, but at 1 Hz most have low values of Q(sub mu) (50-80) in the upper 8 km of the crust, rapidly increasing values to about 1000 at mid-crustal depths, and decreasing values at greater depths. Models which include a layer of higher Q values (80-150) in the upper few km of the crust, overlying a region of low Q values, cannot be predicted by the data of this study. Models for which the frequency dependence is low (0.0-0.1) in the upper crust best explain the available data. In the lower crust that frequency dependence may be substantial and leads to models in which Q(sub mu) may be an order of magnitude lower (approximately 100) at a period of 100 s than it is at 1 s (approximately 1000). GRA

N93-21746# Kakioka Magnetic Observatory (Japan).
REPORT OF THE KAKIOKA MAGNETIC OBSERVATORY, GEOMAGNETISM, KAKIOKA MEMAMBETSU KANOYA, CHICHIJIMA, 1991
1992 221 p
(JMA-159) Avail: CASI HC A10/MF A03

This is one of the annual reports, which presents the results of the magnetic observations carried out at the Kakioka Magnetic Observatory, its two branches at Memambetsu and Kanoya, and an unmanned observatory at Chichijima. The Kakioka Magnetic Observatory, the national standard magnetic observatory of Japan, is one of the organizations administered by the Japan Meteorological Agency. The Kakioka Magnetic Observatory started magnetic observations in 1913 in succession to the Tokyo Observatory (1897 - 1912). The branches at Memambetsu and Kanoya started magnetic observations in 1952 and 1958, respectively. These three observatories are sufficiently free from artificial magnetic disturbances. At Chichijima, we started magnetic observations in 1973. This observatory has been considerably affected by artificial magnetic disturbances due to mainly automobiles. Author

N93-21782# Los Alamos National Lab., NM.
PROXY AND IN-SITU STUDIES OF DAYSIDE MAGNETOPAUSE RECONNECTION
L. Scurry, C. T. Russell (California Univ., Los Angeles.), and J. T. Gosling 1992 12 p Presented at the Solar-Terrestrial Predictions Workshop, Ottawa, Ontario, 18-22 May 1992
(Contract W-7405-eng-36)
(DE93-003740; LA-UR-92-3315; CONF-9205201-2) Avail: CASI HC A03/MF A01

The functional dependence of magnetic reconnection on solar wind

parameters is examined utilizing the am geomagnetic index and satellite observations at the magnetopause. Several parameters in the solar wind are found to control geomagnetic activity. Reconnection is found to be most efficient when the interplanetary magnetic field is southward, although some activity remains when the IMF is horizontal and slightly northward. The reconnection efficiency increases with the solar wind dynamic pressure but decreases when the Mach number is greater than 7.5. These results are compared with the functional dependencies found by correlating solar wind and magnetosheath measurements with observations of accelerated flows at the magnetopause. Accelerated flows are found to occur most often when the interplanetary magnetic field is directed southward. However, accelerated flows do occur when the IMF is horizontal and northward. Accelerated flows are also affected by the magnetosheath beta such that higher beta inhibits their occurrence. The location of accelerated flows indicates that reconnection occurs mainly at the subsolar point. DOE

N93-21783 National Center for Atmospheric Research, Boulder, CO. Atmospheric Chemistry Div.

ISOTOPES OF CARBON MONOXIDE IN THE FREE TROPOSPHERE AND THEIR IMPLICATIONS TO ATMOSPHERIC CHEMISTRY Ph.D. Thesis

John Eugene Mak (California Univ., San Diego.) 1992 120 p

(PB92-218650; NCAR/CT-134) Copyright Avail: Issuing Activity

The thesis project was designed to provide information for the following questions: what is the oxidation capacity of the troposphere, and how are the source strengths of carbon monoxide partitioned. Because of its active role in tropospheric chemistry, carbon monoxide is important in determining the fate of a number of species, including hydroxyl radicals. CO-14 serves as a natural tracer for its destruction, as the source function can be well constrained. By determining the tropospheric inventory of CO-14 and calculating its source strength, one may realize the rate of destruction. Similarly, because certain sources have unique stable isotope signatures, an analysis of the stable isotopes provides information on the relative source strengths. A sampling system was built which allowed for the collection of large, whole air samples from an aircraft platform. CO was extracted and the isotopes were determined, and from these data, an OH abundance was calculated using a 2-D transport model. GRA

N93-21785# Northwestern Univ., Evanston, IL. Dept. of Geological Sciences.

DETERMINATION OF METHANE STABILITY IN THE UPPER MANTLE AND LOWER CRUST Final Report, 1 Jul. 1989 - 30 Jun. 1990

Bernard J. Wood and L. Taras Bryndzia Apr. 1992 82 p In American Journal of Science, 1992 v. 290, p 1-24 Sponsored by Gas Research Institute

(Contract GRI-5087-260-1569)

(PB93-100931; GRI-92/0197) Avail: CASI HC A05/MF A01

In part 1 of the report, the variability in mantle oxygen fugacity f(sub O2) from the Earth's suboceanic upper mantle is examined. The samples they have examined are abyssal spinel peridotites. They chose to study abyssal spinel peridotites as probes of the upper mantle because a sufficient number of samples were available that had a broad global distribution. These provide important constraints on fluid speciation in the system C-O-H, the approximate bulk composition of dominant volatile species in the Earth's upper mantle. Part B of the report presents an analysis of available analytical data on volatiles trapped in quenched mid-oceanic ridge basalt (MORB) glasses from three major oceanic rift systems. The results show that on average, the Earth's suboceanic mantle is more reduced than the subcontinental mantle and that both upper mantle regimes are too oxidized to be in equilibrium with graphite. The results also indicate that conditions favorable to CH4 being an important component of the volatile phase in the upper mantle may be satisfied in the vicinity of mantle plumes (i.e. hot spots). Assuming that the physical and chemical characteristics of mantle plumes are similar beneath the continents, the authors propose that an attractive subject for further research would be to investigate continental supracrustal sedimentary rocks, particularly in regions of continental extension where the manifestation of a subcontinental mantle plume are obvious. GRA

N93-21801# National Inst. of Standards and Technology, Gaithersburg, MD.

WIND AND SEISMIC EFFECTS. PROCEEDINGS OF THE 24TH JOINT MEETING OF THE US-JAPAN COOPERATIVE PROGRAM IN NATURAL RESOURCES PANEL ON WIND AND SEISMIC EFFECTS

Noel J. Raufaste Sep. 1992 600 p Meeting held in Gaithersburg, MD, 19-22 May 1992

(PB93-120152; NIST/SP-843) Avail: CASI HC A25/MF A06; SOD HC

The publication is the proceeding of the 24th Joint Meeting of the U.S.-Japan Panel on Wind and Seismic Effects. The meeting was held at the National Institute of Standards and Technology, Gaithersburg, Maryland during May 19-22, 1992. The proceedings include the program, list of members, panel resolutions, task committee reports, and 45 technical papers. The papers were presented under five themes: (1) Wind Engineering, (2) Storm Surge and Tsunamis, (3) Joint Cooperative Research Program, (4) Earthquake Engineering, and (5) Summaries of Task Committee Workshop Reports (oral presentations only). GRA

N93-21947# Kakioka Magnetic Observatory (Japan).

REPORT OF THE KAKIOKA MAGNETIC OBSERVATORY. GEOELECTRICITY: KAKIOKA, MEMAMBETSU, KANOYA Annual Report, 1991

1992 44 p

(Rept-160) Avail: CASI HC A03/MF A01

This is one of the annual reports, which presents the results of the geoelectric observations carried out at the Kakioka Magnetic Observatory and its two branches at Memambetsu and Kanoya. The Kakioka Magnetic Observatory, the national standard magnetic observatory of Japan, is one of the organizations administered by the Japan Meterological Agency. These observatories started geoelectric observations in 1929, 1949, and 1948 respectively. Author

N93-20076*# Yale Univ., New Haven, CT. Dept. of Geology and Geophysics.

NONLINEAR DYNAMICS OF GLOBAL ATMOSPHERIC AND EARTH SYSTEM PROCESSES

Barry Saltzman *In* NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 29-30 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N93-19964# Air Force Environmental Technical Applications Center, Scott AFB, IL.

SURFACE OBSERVATION CLIMATIC SUMMARIES Report, Nov. 1960 - Sep. 1991

Mar. 1992 315 p

(AD-A258589; USAFETTAC/DS-92/275) Avail: CASI HC A14/MF A03

Surface observation climatic summaries (SOCS) provide statistical climatic summaries of surface weather observations taken and recorded at specified observing station. Hourly observations are summarized from a 10-year period of record. Data is tabulated for climatology, meteorological data, atmospheric phenomena, weather, ceiling, cloud cover, snow depth, humidity, pressure, precipitation, snow, temperature, visibility, wind direction and wind velocity. GRA

N93-19984# Sparta, Inc., Lexington, MA.

ANALYSIS OF SOLAR TRANSMISSION DATA FROM SABLE 89 Report No. 2

D. R. Longtin 1 May 1992 68 p

(Contract F19628-91-C-0093)

(AD-A258602; AD-E201241; LTR92-005; PL-TR-92-2112) Avail: CASI HC A04/MF A01

This study analyzes solar transmissometer data that was taken during the South Atlantic Backscatter Lidar Experiment (SABLE). The instrument operated on six days between 25 June and 7 July 1989. The instrument was located on Ascension Island, and it measured solar transmission at 532 nm versus time and transmission across the solar spectrum. Time

series of solar transmission at 532 nm are used to study the properties of cirrus and boundary layer stratocumulus that passed in front of the sun while the instrument was working. For 25 June 1989, a qualitative assessment shows the transmissions through cirrus to be between 0.4 and 0.8, and the cirrus thicknesses are estimated to be between 1.0 and 2.2 km. These estimates are consistent with cirrus observations and from aircraft. The analysis also focuses on the properties of the stratocumulus cloud edges and thin spots. Stratocumulus are shown to have very similar edge characteristics from day-to-day; there is a uniform distribution of cloud transmission values between about 0.1 and 0.7, and the percentages increase significantly as cloud transmissions increase from 0.7 to 0.9. The number of occurrences of stratocumulus thin spots and edges are then compared against the total number of stratocumulus occurrences. The comparisons clearly show that the stratocumulus over Ascension Island often are not optically thick and they frequently transmit partial direct solar radiation. GRA

N93-19987*# Massachusetts Univ., Amherst. Coll. of Engineering.
THE SPLIT WINDOW MICROWAVE RADIOMETER (SWMR) FOR HURRICANE WIND SPEED MEASUREMENT FROM SPACE Final Report
Calvin T. Swift and P. G. Black (National Oceanic and Atmospheric Administration, Washington, DC.) 27 Jul. 1992 38 p
(Grant NAG1-1318)
(NASA-CR-192316; NAS 1.26:192316) Avail: CASI HC A03/MF A01

The monitoring of hurricanes demands considerable resources each year by the National Oceanic and Atmospheric Administration. Even with the extensive use of satellite and airborne probing of those storms, there is still much uncertainty involved in predicting landfall for timely evacuation of people subject to the threat. The concept of the Split Window Microwave Radiometer (SWMR) is to add an additional capability of remotely measuring surface winds to hopefully improve prediction capabilities or at least define the severity of the storm while it is far from land. Some of the present science and observational needs are addressed in this report as are remote sensing limitations which impact the design of a minimal system which can be launched into low earth orbit by a low cost launch system. This study has concluded that wind speed and rain rate maps of hurricanes can be generated with an X-Band radiometer system with an antenna whose aperture is 2 m on a side. Author

N93-19994# Analytic Sciences Corp., Reading, MA.
PL/GPD DMSP DATA ARCHIVING FROM VAX TO EXABYTE TAPES Report No. 1
David B. Lapadula and Maurice Ling Dec. 1991 30 p
(Contract F19625-91-C-0117)
(AD-A258607; AD-E201238; TASC-TR-6397-2-1; PL-TR-92-2017) Avail: CASI HC A03/MF A01

This report describes the archiving of Defense Meteorological Satellite Program (DMSP) data from VAX tapes to Exabyte tapes mounted on SPARC stations. This effort encompasses automatic creation of filenames for the data fields, transferral from one environment (VAX) to another (Unix), logistics for each step of the operation, devising a Data Dictionary file to provide the user information regarding the data format used for each file, writing a User's Guide for the archiving process, and training PL/GPD personnel how to archive and retrieve the data efficiently and accurately. GRA

N93-20031# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
THE ROLE OF CONDITIONAL SYMMETRIC INSTABILITY IN THE DEVELOPMENT OF MODERATE TO HEAVY FROZEN PRECIPITATION BANDS M.S. Thesis
Thomas E. Lambert 1992 127 p
(AD-A258575; AFIT/CI/CIA-92-100) Avail: CASI HC A07/MF A02

The relationship between conditional symmetric instability (CSI), slantwise convection, and heavy frozen precipitation in winter type extratropical cyclones (ETCs) is analyzed for several cases where thunder and frozen precipitation were reported. Analysis of the atmosphere's vertical temperature, humidity, and wind field structure was used to identify areas of CSI and the atmospheric conditions that may serve as precursors to the development of CSI. Vertical cross sections showing areas of CSI were used to provide insight into when and where slantwise convection could be expected. A correlation was found between vertical motion, vertical wind shear, the equivalent potential temperature (theta-e) field, and areas of CSI, slantwise convection, and heavy frozen precipitation. Regions of moderate to strong upward vertical motion, strong vertical wind shear, and small increases or even decreases in theta-e with height are the regions where CSI tends to develop in winter type ETCs. Areas of CSI were present in all cases where thunder and frozen precipitation were reported. CSI creates conditions favorable for the development of slantwise convection and the heavy frozen precipitation it sometimes produces. GRA

N93-20038*# Pennsylvania State Univ., University Park. Dept. of Meteorology.
STRATIFORM CLOUDS AND THEIR INTERACTION WITH ATMOSPHERIC MOTION Final Technical Report, 15 Jun. 1991 - 15 Jun. 1992
John H. E. Clark and Hampton N. Shirer 22 Feb. 1993 32 p
(Grant NAG8-780)
(NASA-CR-192280; NAS 1.26:192280) Avail: CASI HC A03/MF A01

The spatial patterns of stratocumulus cloud frequency for the continental United States and adjacent oceans were routinely obtained from surface cloud observations every six hours. These frequencies were correlated with upper air patterns at 850, 700, and 500 mb. Significant frequency maxima were found near trough axes over marine areas during relatively stationary large-scale wave patterns. These maxima tended to occur to the east of trough axes. Over continental regions, there was little relationship between stratocumulus and synoptic-scale flows patterns, probably because of the short lifetime of cloud over land. A summary of these findings is included. Derived from text

N93-20046*# Utah Univ., Salt Lake City. Center for Atmospheric and Remote Sounding Studies.
THE EFFECTS OF SMALL ICE CRYSTALS ON THE INFRARED RADIATIVE PROPERTIES OF CIRRUS CLOUDS Semiannual Status Report, 1 Oct. 1989 - 31 Mar. 1990
Y. Takano, K. N. Liou, S. Asano (Meteorological Research Inst., Tsukuba, Japan.), A. Heymsfield (National Center for Atmospheric Research, Boulder, CO.), and P. Minnis (National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.) 30 Apr. 1990 4 p
(Grant NAG1-1048)
(NASA-CR-192181; NAS 1.26:192181) Avail: CASI HC A01/MF A01

To be successful in the development of satellite retrieval methodologies for the determination of cirrus cloud properties, we must have fundamental scattering and absorption data on nonspherical ice crystals that are found in cirrus clouds. Recent aircraft observations (Platt et al. 1989) reveal that there is a large amount of small ice particles, on the order of 10 micron, in cirrus clouds. Thus it is important to explore the potential differences in the scattering and absorption properties of ice crystals with respect to their sizes and shapes. In this study the effects of nonspherical small ice crystals on the infrared radiative properties of cirrus clouds are investigated using light scattering properties of spheroidal particles. In Section 2, using the anomalous diffraction theory for spheres and results from the exact spheroid scattering program, efficient parameterization equations are developed for calculations of the scattering and absorption properties for small ice crystals. Parameterization formulas are also developed for large ice crystals using results computed from the geometric ray-tracing technique and the Fraunhofer diffraction theory for spheroids and hexagonal crystals. This is presented in Section 3. Finally, applications to the satellite remote sensing are described in Section 4. Author

N93-20067*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
NASA/MSFC FY92 EARTH SCIENCE AND APPLICATIONS PROGRAM RESEARCH REVIEW
James E. Arnold, ed. and Fred W. Leslie, ed. Washington Jan. 1993 116 p Workshop held in Huntsville, AL, 7-9 Jul. 1992
(NASA-CP-3184; M-704; NAS 1.55:3184) Avail: CASI HC A06/MF A02

A large amount of attention has recently been given to global issues such as the ozone hole, tropospheric temperature variability, etc. A scientific challenge is to better understand atmospheric processes on a variety of spatial and temporal scales in order to predict environmental changes. Measurement of geophysical parameters such as wind, temperature, and moisture are needed to validate theories, provide analyzed data sets, and initialize or constrain numerical models. One of NASA's initiatives is the Mission to Planet Earth Program comprised of an Earth Observation System

(EOS) and the scientific strategy to analyze these data. This work describes these efforts in the context of satellite data analysis and fundamental studies of atmospheric dynamics which examine selected processes important to the global circulation. For individual titles, see N93-20068 through N93-20108.

N93-20068*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

GLOBAL TEMPERATURE VARIATIONS

Roy W. Spencer and John R. Christy (Alabama Univ., Huntsville.) *In its* NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 1-2 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

Lower stratospheric temperature anomalies from MSU channel 4 were compared to ten years of radiosonde data to validate the satellite record, and the results were submitted for publication. Various assumed stratospheric weighting profiles were tested to determine whether the theoretical channel 4 weighting function had significant errors. It was found that the real weighting function is slightly sharper than the theoretical weighting function. We also found evidence for a step-function cooling in the radiosonde record during 1982, a period when two satellites were operating with no evidence of changes in the satellites. Lower tropospheric bulk temperature datasets continue to be sent to climate researchers and modelers, as well as to the Climate Analysis Center (CAC). The CAC is also implementing our MSU software to be able to do the MSU processing at their site. Drift in MSU channel 3 is being quantified and corrected to allow it to be used together with channel 2 for a better lowertropospheric gridpoint temperature product. A new global oceanic precipitation dataset has been produced from MSU channel 1 data, and compared to ten years of global raingage data. Author

N93-20069*# Bristol Univ. (England).

GLOBAL RAINFALL MONITORING BY SSM/I

Eric C. Barrett, C. Kidd, and D. Kniveton *In* NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 3-5 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

Significant accomplishments in the last year of research are presented. During 1991, three main activities were undertaken: (1) development and testing of a preliminary global rainfall algorithm; (2) researching areas of strong surface scattering; and (3) formulation of a program of work for the WetNet PrecipWG. Focus of present research and plans for next year are briefly dismissed. Author

N93-20070*# Wisconsin Univ., Madison.

INTERACTIVE ACCESS AND MANAGEMENT FOR FOUR-DIMENSIONAL ENVIRONMENTAL DATA SETS USING McIDAS **c42**

William L. Hibbard and Gregory J. Tripoli *In* NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 11-14 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

Significant accomplishments in the past year are presented and include the following: (1) enhancements to VIS-5D; (2) Implementation of the VIS AD System; and (3) numerical modeling applications. Focus of current research and plans for next year in the following areas are briefly discussed: (1) continued development and application of the VIS-AD system; (2) further enhancements to VIS-5D; and (3) plans for modeling applications. Author

N93-20071*# Colorado Univ., Boulder. Dept. of Astrophysical, Planetary, and Atmospheric Sciences.

PLANETARY CIRCULATIONS IN THE PRESENCE OF TRANSIENT AND SELF-INDUCED HEATING

Murry L. Salby and Rolando R. Garcia (National Center for Atmospheric Research, Boulder, CO.) *In* NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 15-16 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

The research program focuses on large-scale circulations and their interaction with the global convective pattern. An 11-year record of global cloud imagery and contemporaneous fields of motion and temperature have been used to investigate organized convection and coherent variability of the tropical circulation operating on intraseasonal time scales. This study provides a detailed portrait of tropical variability associated with the so-called Madden-Julian Oscillation (MJO). It reveals the nature, geographical distribution, and seasonality of discrete convective signal, which is a measure of feedback between the circulation and the convective pattern. That discrete spectral behavior has been evaluated in light of natural variability of the ITCZ associated with climatological convection. A composite signature of the MJO, based on cross-covariance statistics of cloud cover, motion, and temperature, has been constructed to characterize the lifecycle of the disturbance in terms of these properties. The composite behavior has also been used to investigate the influence the MJO exerts on the zonal-mean circulation and the involvement of the MJO in transfers of momentum between the atmosphere and the solid Earth. The aforementioned observational studies have led to the production of two animations. One reveals the convective signal in band-pass filtered OLR and compares it to climatological convection. The other is a 3-dimensional visualization of the composite lifecycle of the MJO. With a clear picture of the MJO in hand, feedback between the circulation and the convective pattern can be diagnosed meaningfully in numerical simulations. This process is being explored in calculations with the linearized primitive equations on the sphere in the presence of realistic stability and shear. The numerical framework represents climatological convection as a space-time stochastic process and wave-induced convection in terms of the vertically-integrated moisture flux convergence. In these calculations, frictional convergence near the equator emerges as a key to feedback between the circulation and the convective pattern. At low latitudes, nearly geostrophic balance in the boundary layer gives way to frictional balance. This shifts the wave-induced convection into phase with the temperature anomaly and allows the attending heating to feed back positively onto the circulation. The calculations successfully reproduce the salient features of the MJO. They are being used to understand the growth and decay phases of the composite lifecycle and the conditions that favor amplification of the MJO. Author

N93-20072*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

CLOUD RADIATIVE FORCING EFFECTS ON OBSERVED AND SIMULATED GLOBAL ENERGETICS

Byung-Ju Sohn and Franklin Robertson *In its* NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 17-18 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

The research objectives are the following: (1) to examine how cloud-radiation processes generate/destroy available potential energy by altering both meridional and zonal temperature gradient; (2) to investigate how the atmospheric dynamic fields respond to the cloud-altered mass distributions through the energy conversion circuit; and (3) to examine how the improved version of CCM1 simulates observationally obtained cloud-radiative forcing and its associated energetics and circulations. Significant accomplishments in the past year towards obtaining these objectives and the focus of current research and plans for next year are discussed. CASI

N93-20073*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

BASIC STUDIES OF BAROCLINIC FLOWS

Timothy L. Miller, Fred W. Leslie, H.-I. Lu, and K. A. Butler *In its* NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 19-20 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

A fully nonlinear 3-dimensional numerical model (GEOSIM), previously developed and validated for several cases of geophysical fluid flow, has been used to investigate the dynamical behavior of laboratory experiments of fluid flows similar to those of the Earth's atmosphere. The phenomena investigated are amplitude vacillation, and the response of the fluid system to uneven heating and cooling. The previous year's work included hysteresis in the transition between axisymmetric and wave flow. Investigation is also continuing of the flows in the Geophysical Fluid Flow Cell (GFFC), a low-gravity Spacelab experiment. Much of the effort in the past year has

been spent in validation of the model under a wide range of external parameters including nonlinear flow regimes. With the implementation of a 3-dimensional upwind differencing scheme, higher spectral resolution, and a shorter time step, the model has been found capable of predicting the majority of flow regimes observed in one complete series of baroclinic annulus experiments of Pfeffer and co-workers. Detailed analysis of amplitude vacillation has revealed that the phase splitting described in the laboratory experiments occurs in some but not all cases. Through the use of animation of the models output, a vivid 3-dimensional view of the phase splitting was shown to the audience of the Southeastern Geophysical Fluid Dynamics Conference in March of this year. A study on interannual variability was made using GEOSIM with periodic variations in the thermal forcing. Thus far, the model has not predicted a chaotic behavior as observed in the experiments, although there is a sensitivity in the wavenumber selection to the initial conditions. Work on this subject, and on annulus experiments with non-axisymmetric thermal heating, will continue. The comparison of GEOSIM's predictions will result from the Spacelab 3 GFFC experiments continued over the past year, on a 'back-burner' basis. At this point, the study (in the form of a draft of a journal article) is nearly completed. The results from GEOSIM compared very well with the experiments, and the use of the model allows the demonstration of flow mechanics that were not possible with the experimental data. For example, animation of the model output shows that the forking of the spiral bands is a transient phenomenon, due to the differential east-west propagation of convection bands from different latitudes. CASI

N93-20074*# Colorado Univ., Boulder. Dept. of Astrophysical, Planetary, and Atmospheric Sciences.

LABORATORY AND THEORETICAL MODELS OF PLANETARY-SCALE INSTABILITIES AND WAVES

John E. Hart *In* NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 21-23 (For primary document see N93-20067 07-47)
Avail: CASI HC A01/MF A02

Research work is proceeding in theoretical, numerical, and experimental geophysical fluid dynamics leading up to a reflight of the GFFC (Geophysical Fluid Flow Cell Experiment) on USML-2. The work is intended not only to generate ideas for future space experiments, but to provide fundamental results concerned with nonlinear and chaotic properties of thermal convection and baroclinic waves in terrestrial and planetary atmospheres. The major efforts are focussed on thermal convection in a rapidly rotating annulus relevant to Jovian atmospheric dynamics, and on the chaotic behavior of baroclinic waves relevant to the Earth's atmosphere. The approach, in preparation for USML-2, is primarily theoretical and numerical. Mechanistic process models are solved numerically in order to identify physical mechanisms that may be observed in the GFFC, and which are important in real geophysical applications. The results from numerical simulations of geophysical fluid flow (subject to rotation and stratification) are compared with previous GFFC experiments on Spacelab-3 and with existing and proposed terrestrial laboratory experiments of various types. Pattern recognition algorithms have been employed to generate low-dimensional descriptions of the highly nonlinear and turbulent numerical simulations. Such empirically truncated descriptions provide for simplified but robust physical interpretations of the dynamics, as well as yielding highly efficient computations of these chaotic flows. Author

N93-20075*# National Center for Atmospheric Research, Boulder, CO.

RESEARCH ON DIABATIC INITIALIZATION

Akira Kashara *In* NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 25-28 (For primary document see N93-20067 07-47)
Avail: CASI HC A01/MF A02

The objective of this research is to contribute to the improvement of the analyses of irrotational wind and moisture fields in the tropics through advancement in the technique of initialization, incorporating diabatic effects and use of satellite-derived, radiometric imagery data that are not used currently by operational centers. Significant accomplishments during the period of May 1991 - April 1992 in research involving the following are presented: impact of tropical initialization upon the spin-up of precipitation forecasts; and a unified approach to diabatic initialization for improvement in the analysis of divergence and water vapor fields in the tropics. Focus of current research and plans for next year are discussed with respect to the topics of controlling the precipitation over shoot during the early part of a numerical forecast and the use of satellite imagery data for improvement of the tropical analysis. CASI

N93-20076*# Yale Univ., New Haven, CT. Dept. of Geology and Geophysics.

NONLINEAR DYNAMICS OF GLOBAL ATMOSPHERIC AND EARTH SYSTEM PROCESSES **c46**

Barry Saltzman *In* NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 29-30 (For primary document see N93-20067 07-47)
Avail: CASI HC A01/MF A02

During the past eight years, we have been engaged in a NASA-supported program of research aimed at establishing the connection between satellite signatures of the earth's environmental state and the nonlinear dynamics of the global weather and climate system. Thirty-five publications and four theses have resulted from this work, which included contributions in five main areas of study: (1) cloud and latent heat processes in finite-amplitude baroclinic waves; (2) application of satellite radiation data in global weather analysis; (3) studies of planetary waves and low-frequency weather variability; (4) GCM studies of the atmospheric response to variable boundary conditions measurable from satellites; and (5) dynamics of long-term earth system changes. Significant accomplishments from the three main lines of investigation pursued during the past year are presented and include the following: (1) planetary atmospheric waves and low frequency variability; (2) GCM studies of the atmospheric response to changed boundary conditions; and (3) dynamics of long-term changes in the global earth system. CASI

N93-20077*# California Univ., Davis. Dept. of Land, Air, and Water Resources.

LIFE CYCLES OF TRANSIENT PLANETARY WAVES

Terrence Nathan *In* NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 31-33 (For primary document see N93-20067 07-47)
Avail: CASI HC A01/MF A02

In recent years there has been an increasing effort devoted to understanding the physical and dynamical processes that govern the global-scale circulation of the atmosphere. This effort has been motivated, in part, from: (1) a wealth of new satellite data; (2) an urgent need to assess the potential impact of chlorofluorocarbons on our climate; (3) an inadequate understanding of the interactions between the troposphere and stratosphere and the role that such interactions play in short and long-term climate variability; and (4) the realization that addressing changes in our global climate requires understanding the interactions among various components of the earth system. The research currently being carried out represents an effort to address some of these issues by carrying out studies that combine radiation, ozone, seasonal thermal forcing and dynamics. Satellite and ground-based data that is already available is being used to construct basic states for our analytical and numerical models. Significant accomplishments from 1991-1992 are presented and include the following: ozone-dynamics interaction; (2) periodic local forcing and low frequency variability; and (3) steady forcing and low frequency variability. Author

N93-20078*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

GLOBAL WATER CYCLE

Franklin Robertson, Steven J. Goodman, John R. Christy (Alabama Univ., Huntsville.), Daniel E. Fitzjarrald, Shi-Hung Chou, William Crosson (Universities Space Research Association, Huntsville, AL.), Shouping Wang (Universities Space Research Association, Huntsville, AL.), and Jorge Ramirez (Colorado State Univ., Fort Collins.) *In its* NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 35-37 (For primary document see N93-20067 07-47)
Avail: CASI HC A01/MF A02

This research is the MSFC component of a joint MSFC/Pennsylvania State University Eos Interdisciplinary Investigation on the global water cycle extension across the earth sciences. The primary long-term objective of this investigation is to determine the scope and interactions of the global water cycle with all components of the Earth system and to understand how it stimulates and regulates change on both global and regional scales.

Significant accomplishments in the past year are presented and include the following: (1) water vapor variability; (2) multi-phase water analysis; (3) global modeling; and (4) optimal precipitation and stream flow analysis and hydrologic processes. Author

N93-20079*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

COORDINATED FIELD STUDY FOR CaPE: ANALYSIS OF ENERGY AND WATER BUDGETS

Steven J. Goodman, Claude Duchon (Oklahoma Univ., Norman.), Edward T. Kanemasu (Georgia Univ., Griffin.), Eric A. Smith (Florida State Univ., Tallahassee.), William Crosson (Universities Space Research Association, Huntsville, AL.), Chip Laymon (Universities Space Research Association, Huntsville, AL.), and Jeff Luvall *In its* NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 39 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

The objectives of this hydrologic cycle study are to understand and model (1) surface energy and land-atmosphere water transfer processes, and (2) interactions between convective storms and surface energy fluxes. A surface energy budget measurement campaign was carried out by an interdisciplinary science team during the period July 8 - August 19, 1991 as part of the Convection and Precipitation/Electrification Experiment (CaPE) in the vicinity of Cape Canaveral, FL. Among the research themes associated with CaPE is the remote estimation of rainfall. Thus, in addition to surface radiation and energy budget measurements, surface mesonet, special radiosonde, precipitation, high-resolution satellite (SPOT) data, geosynchronous (GOES) and polar orbiting (DMSP SSM/I, OLS; NOAA AVHRR) satellite data, and high altitude airplane data (AMPR, MAMS, HIS) were collected. Initial quality control of the seven surface flux station data sets has begun. Ancillary data sets are being collected and assembled for analysis. Browsing of GOES and radar data has begun to classify days as disturbed/undisturbed to identify the larger scale forcing of the pre-convective environment, convection storms and precipitation. The science analysis plan has been finalized and tasks assigned to various investigators. CASI

N93-20080*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

INVESTIGATION OF THE ROLE OF THERMAL BOUNDARY LAYER PROCESSES IN INITIATING CONVECTION UNDER THE NASA SPACE FIELD PROGRAM

Richard T. McNider (Alabama Univ., Huntsville.), Aaron Song (Alabama Univ., Huntsville.), Dan Casey (Alabama Univ., Huntsville.), William Crosson (Universities Space Research Association, Huntsville, AL.), and Peter Wetzel *In* NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 41 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

The current NWS ground based network is not sufficient to capture the dynamic or thermodynamic structure leading to the initiation and organization of air mass moist convective events. Under this investigation we intend to use boundary layer mesoscale models (McNider and Pielke, 1981) to examine the dynamic triggering of convection due to topography and surface thermal contrasts. VAS and MAN's estimates of moisture will be coupled with the dynamic solution to provide an estimate of the total convective potential. Visible GOES images will be used to specify incoming insolation which may lead to surface thermal contrasts and JR skin temperatures will be used to estimate surface moisture (via the surface thermal inertia) (Weizel and Chang, 1988) which can also induce surface thermal contrasts. We will use the SPACE-COHMEX data base to evaluate the ability of the joint mesoscale model satellite products to show skill in predicting the development of air mass convection. We will develop images of model vertical velocity and satellite thermodynamic measures to derive images of predicted convective potential. We will then after suitable geographic registration carry out a pixel by pixel correlation between the model/satellite convective potential and the 'truth' which are the visible images. During the first half of the first year of this investigation we have concentrated on two aspects of the project. The first has been in generating vertical velocity fields from the model for COHMEX case days. We have taken June 19 as the first case and have run the mesoscale model at several different grid resolutions. We are currently developing the composite model/satellite convective image. The second aspect has been the attempted calibration of the surface energy budget to provide the proper horizontal thermal contrasts for convective initiation. We have made extensive progress on this aspect using the FIFE data as a test data set. The calibration technique looks very promising. CASI

N93-20081*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

AMPR/SSMI DATA COMPARISONS

Roy W. Spencer, Robbie Hood, Mark James, Eric Cantrel, Dave Simmons (Sverdrup Technology, Inc., Huntsville, AL.), John Jackson (Sverdrup Technology, Inc., Huntsville, AL.), and Frank LaFontaine (Universities Space Research Association, Huntsville, AL.) *In its* NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 43 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

The AMPR was flown during CAPE and STORMFEST, during which some good data were gathered. Significant instrument noise problems were encountered in both deployments which appear to be temperature related. These are being fixed before the TOGA COARE deployment. New calibration loads have also been manufactured for the TOGA COARE configuration. Eric Smith at FSU had been analyzing the AMPR data and has written a journal article to be submitted early this summer. The emphasis of his work is on the interpretation of low resolution microwave data from space, based upon what we have learned from the high-resolution AMPR signatures. Author

N93-20082*# Texas A&M Univ., College Station. Dept. of Meteorology.

WetNet: USING SSM/I DATA INTERACTIVELY FOR GLOBAL DISTRIBUTION OF TROPICAL RAINFALL AND PRECIPITABLE WATER

Edward J. Zipser and James P. McGuirk *In* NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 45-47 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

The research objectives were the following: (1) to use SSM/I to categorize, measure, and parameterize effects of rainfall systems around the globe, especially mesoscale convective systems; (2) to use SSM/I to monitor key components of the global hydrologic cycle, including tropical rainfall and precipitable water, and links to increasing sea surface temperatures; and (3) to assist in the development of efficient methods of exchange of massive satellite data bases and of analysis techniques, especially their use at a university. Numerous tasks have been initiated. First and foremost has been the integration and startup of the WetNet computer system into the TAMU computer network. Scientific activity was infeasible before completion of this activity. Final hardware delivery was not completed until October 1991, after which followed a period of identification and solution of several hardware and software and software problems. Accomplishments representing approximately four months work with the WetNEt system are presented. Author

N93-20083*# Utah State Univ., Logan.

IMPROVEMENT AND FURTHER DEVELOPMENT OF SSM/I OVERLAND PARAMETER ALGORITHMS USING THE WetNet WORKSTATION

Christopher M. U. Neale, Jeffrey J. McDonnell, Douglas Ramsey, Lawrence Hipps, and David Tarboton *In* NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 49-51 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

Since the launch of the DMSP Special Sensor Microwave/Imager (SSM/I), several algorithms have been developed to retrieve overland parameters. These include the present operational algorithms resulting from the Navy calibration/validation effort such as land surface type (Neale et al. 1990), land surface temperature (McFarland et al. 1990), surface moisture (McFarland and Neale, 1991) and snow parameters (McFarland and Neale, 1991). In addition, other work has been done including the classification of snow cover and precipitation using the SSM/I (Grody, 1991). Due to the empirical nature of most of the above mentioned algorithms, further research is warranted and improvements can probably be obtained through a combination of radiative transfer modelling to study the physical processes governing the microwave emissions at the SSM/I frequencies, and the incorporation of additional ground truth data and special cases into the

regression data sets. We have proposed specifically to improve the retrieval of surface moisture and snow parameters using the WetNet SSM/I data sets along with ground truth information namely climatic variables from the NOAA cooperative network of weather stations as well as imagery from other satellite sensors such as the AVHRR and Thematic Mapper. In the case of surface moisture retrievals the characterization of vegetation density is of primary concern. The higher spatial resolution satellite imagery collected at concurrent periods will be used to characterize vegetation types and amounts which, along with radiative transfer modelling should lead to more physically based retrievals. Snow parameter retrieval algorithm improvement will initially concentrate on the classification of snowpacks (dry snow, wet snow, refrozen snow) and later on specific products such as snow water equivalent. Significant accomplishments in the past year are presented.

Author

N93-20084*# Chicago Univ., IL.

CLIMATIC VARIATION OF STORMS

Ted Fujita *In* NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 53-55 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

Long-term variation of U.S. tornadoes were studied by obtaining the best possible data during the 75 years, 1916-90. The most difficult task was to estimate the number of early tornadoes in 1916-50 when the reporting efficiency was very bad, resulting in undercounting of the incidents. In generating the best possible data, Fujita's Tornado Tape produced at the University of Chicago, the book Significant Tornadoes, 1880-1989, by Thomas P. Grazulis, and the NSSFC Tornado Tape were combined. First, the annual number of tornadoes were smoothed to obtain the smoothed number of annual tornadoes which was normalized to the standard number of tornadoes defined as the mean number in the recent 30 years 1960-89. The normalization factor was obtained by computing the ration of smoothed and standard number. In the early years, the factor was in excess of 7. Thereafter, the normalized number of annual tornadoes was computed and plotted, finding that the results are very satisfactory. In order to visualize the variation of tornado activities, the tornado activity number (TAN) was initiated and computed. The TAN including all annual tornadoes show certain periodicity. For climatological evaluation, the peak-activity day of each year, such as Superoutbreak day, 3 April 1974, Palm Sunday, 11 April 1965 were eliminated. The TAN, excluding peak-day tornadoes, is of extreme interest.

CASI

N93-20085*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

OLS DATA SYSTEM/GLOBAL SURVEY OF LIGHTNING

Steven J. Goodman, Hugh Christian, Pat Wright (Universities Space Research Association, Huntsville, AL.), and Greg Scharfen (International Geophysical Year World Data Center A, Boulder, CO.) *In its* NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 57 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

A global lightning climatology is being assembled from the nighttime imagery of the DMSP Optical Linescan Sensor (OLS). Lightning saturates the visible channel of the OLS at nighttime and can be identified as a horizontal streak on the order of 50-100 km in horizontal extent. Lightning streaks apparent in the film strips located at the National Snow and Ice Data Center (NSIDC) prior to 1991 are being digitized. An initial survey was completed for the F7 satellite observation period January 1986 - October 1987 and for the Q satellite for the period June-July 1973. Comparisons between the OLS lightning climatology with the Arkin GPI data set during the 1986-87 El Nino event shows similar regional variations in convective activity. The digital archive of global DMSP data began at the end of February. Software is being developed at both MSFC and NSIDC to extract, navigate, and view the OLS fine and smooth imagery.

Author

N93-20086*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

ATMOSPHERIC ELECTRICITY/METEOROLOGY ANALYSIS

Steven J. Goodman, Richard Blakeslee, and Dennis Buechler (Alabama Univ., Huntsville.) *In its* NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 59 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

This activity focuses on Lightning Imaging Sensor (LIS)/Lightning Mapper Sensor (LMS) algorithm development and applied research. Specifically we are exploring the relationships between (1) global and regional lightning activity and rainfall, and (2) storm electrical development, physics, and the role of the environment. U.S. composite radar-rainfall maps and ground strike lightning maps are used to understand lightning-rainfall relationships at the regional scale. These observations are then compared to SSM/I brightness temperatures to simulate LIS/TRMM multi-sensor algorithm data sets. These data sets are supplied to the WETNET project archive. WSR88-D (NEXRAD) data are also used as it becomes available. The results of this study allow us to examine the information content from lightning imaging sensors in low-earth and geostationary orbits. Analysis of tropical and U.S. data sets continues. A neural network/sensor fusion algorithm is being refined for objectively associating lightning and rainfall with their parent storm systems. Total lightning data from interferometers are being used in conjunction with data from the national lightning network. A 6-year lightning/rainfall climatology has been assembled for LIS sampling studies.

CASI

N93-20087*# New Mexico Inst. of Mining and Technology, Socorro. Dept. of Physics.

ELECTRIFICATION IN WINTER STORMS AND THE ANALYSIS OF THUNDERSTORM OVERFLIGHT DATA

Marx Brook IN NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 61-63 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

We have been focusing our study of electrification in winter storms on the lightning initiation process, making inferences about the magnitude of the electric fields from the initial pulses associated with breakdown, i.e., with the formation of the initial streamers. The essence of the most significant finding is as follows: (1) initial breakdown radiation pulses from stepped leaders prior to the first return stroke are very large, reaching values of 20-30 Volts/meter, comparable to return stroke radiation; and (2) the duration of the stepped leader, from the initial detectable radiation pulse to the return stroke onset, is very-short-ranging from a minimum 1.5 ms to a maximum of 4.5 ms. This past summer (June-August of 1991) we participated in the CAPE program at the Kennedy Space Center in order to acquire data on stepped leaders in summer storms with the same equipment used to get the winter storm data. We discovered that the vigorous leaders seen in winter so frequently were present in summer storms, although not as large in amplitude and certainly not as frequent.

Author

N93-20088*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

ER-2 INVESTIGATIONS OF LIGHTNING AND THUNDERSTORMS

Richard Blakeslee *In its* NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 65-67 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

The primary objective of the ER-2 lightning program is to investigate relationships between lightning and storm electrification and a number of underlying and interrelated phenomena including the structure, dynamics, and evolution of thunderstorms and thunderstorm systems, precipitation distribution and amounts, atmospheric chemistry processes, and the global electric circuit. This research is motivated by the desire to develop an understanding needed for the effective utilization and interpretation of data from the Lighting Imaging Sensor (LIS), the Lightning Mapper Sensor (LMS), and other satellite-based lightning detectors planned for the late 1900's and early 2000's. These satellite lightning detection systems will be characterized by high detection efficiencies (i.e., 90 percent) and the capability to detect both intracloud and cloud-to-ground discharges during day and night. The Lightning Imaging Sensor (LIS) is being developed by NASA for the Tropical Rainfall Measuring Mission (TRMM) satellite. In the ER-2 and related investigations, the emphasis is on establishing quantitative relationships and developing practical algorithms that employ lightning data, such as could be derived from satellite observations of optical lightning emissions, as the independent variable. Significant accomplishments made during the past year are presented.

Author

N93-20089*# Georgia Inst. of Tech., Atlanta. School of Electrical Engineering.

AIRBORNE FULL POLARIZATION RADIOMETRY USING THE MSFC ADVANCED MICROWAVE PRECIPITATION RADIOMETER (AMPR)

Al J. Gasiewski and D. B. Kunkee *In* NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 69-70 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

The applications of vertically and horizontally polarized brightness temperatures in both atmospheric and surface remote sensing have been long recognized by many investigators, particularly those studying SMMR and SSM/I data. Here, the large contrast between the first two Stokes' parameters (T(sub V) and T(sub H)) can be used for detection of sea ice, measurement of ocean surface wind speed, and measurement of cloud and water vapor opacity. High-resolution aircraft data from instruments such as the NASA/MSFC AMPR is crucial for verifying radiative transfer models and developing retrieval algorithms. Currently, the AMPR is outfitted with single-polarization channels at 10, 18, 37 and 85 GHz. To increase its utility, it is proposed that additional orthogonal linearly polarized channels be added to the AMPR. Since the AMPR's feedhorns are already configured for dual orthogonal linearly polarized modes, this would require only a duplication of the currently existing receivers. To circumvent the resulting polarization basis skew caused by the cross-track scanning mechanism, the technique of Electronic Polarization Basis Rotation is proposed to be implemented. Implementation of EPBR requires precise measurement of the third Stokes parameter and will eliminate polarization skew by allowing the feedhorn basis skew angle to be corrected in software. In addition to upgrading AMPR to dual polarization capability (without skew), the modifications will provide an opportunity to demonstrate EPBR on an airborne platform. This is a highly desirable intermediate step prior to satellite implementation. Author

N93-20090*# Universities Space Research Association, Huntsville, AL.

NONHYDROSTATIC EFFECTS IN NUMERICAL MODELING OF MESOSCALE CONVECTIVE SYSTEMS AND BAROCLINIC WAVES

Charles Cohen *In* NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 71 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

The present investigation is concerned with the role of convection upon mesoscale modeling results, particularly when the grid resolution becomes small enough that there is not a clear scale separation between the explicitly resolved circulations and the parameterized clouds. In those situations, the vertical accelerations in explicitly resolved circulations become strong enough that the hydrostatic assumption may no longer be valid. These concerns arise from interests in improving mesoscale modeling per se and in improving the subgrid-scale parameterizations in global models. The hydrostatic and the nonhydrostatic options of the Colorado State University Regional Atmospheric Modeling System were used to simulate dry gravity currents in two dimensions, using several different horizontal grid sizes. With horizontal grid intervals of 10 km or less, nonhydrostatic simulations produce wider and colder heads and weaker but wider forced updrafts than do the hydrostatic simulations. Comparing the hydrostatic and nonhydrostatic models show that the difference between the vertical mass fluxes is much less than the difference between the vertical velocities. When the grid is fine enough to resolve the head of the gravity current, horizontal convergence at the gust front extends upwards almost to the head of the cold air. Vertical mass flux in the forced updraft at the front varies with horizontal grid size mainly as a function of the height of the simulated head. For coarser grids, which do not resolve the head, vertical mass flux at all heights decreases with increasing horizontal grid size. A comparison on nonhydrostatic simulations with horizontal grid intervals of 1 km and 2 km illustrates how decreasing the grid size does not necessarily increase the intensity of the resolved circulation. The smaller grid enables the simulated gravity current to entrain a bubble of warm air behind the head, which results in a weaker circulation with a shorter head and weaker updraft. Author

N93-20091*# Purdue Univ., West Lafayette, IN. Dept. of Earth and Atmospheric Sciences.

SYNOPTIC/PLANETARY-SCALE INTERACTIONS AND BLOCKING OVER THE NORTH ATLANTIC OCEAN

Phillip J. Smith, Anthony R. Lupo, Melinda L. Hunter, and David R. Stettner *In* NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 73-75 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

The central theme of this project has been the diagnosis of blocking anticyclogenesis and the corresponding interactions with synoptic-scale circulations. To that end an extensive investigation of the dynamics and energetics of a major blocking anticyclone and two upstream cyclones, all of which occurred over the North Atlantic Ocean and the United States in January 1979, was undertaken. Data for the study were provided by Goddard Laboratory for Atmospheres (GLA) 4 LAT by 5 LON FGGE analyses. The methodology has primarily focused on the diagnosis of circulation forcing mechanisms using the modified forms (referred to as the extended forms) of the height tendency and Zwack-Okossi equations developed by our research group. Calculations use routine second-order finite differencing with boundary layer fraction and sensible heating and latent heat release represented as parameterized quantities. Of particular interest are the latent heat release estimates, which combine convectional parameterized values with estimates derived from satellite IR data. The latter were obtained using an algorithm derived by Dr. Franklin R. Robertson of NASA's Marshall Space Flight Center. Results are contained in project reports, theses and publications identified in previous review summaries and reports, and publications listed at the end of this summary. Significant accomplishments in the past year are presented. Author

N93-20092*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

OBSERVATIONAL AND MODELING STUDIES OF HEAT, MOISTURE, PRECIPITATION, AND GLOBAL-SCALE CIRCULATION PATTERNS

Dayton G. Vincent (Purdue Univ., Elkhart, IN.) and Franklin Robertson *In its* NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 77-79 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

The research sponsored by this grant is a continuation and an extension of the work conducted under a previous contract, 'South Pacific Convergence Zone and Global-Scale Circulations'. In the prior work, we conducted a detailed investigation of the South Pacific convergence zone (SPCZ), and documented many of its significant features and characteristics. We also conducted studies of its interaction with global-scale circulation features through the use of both observational and modeling studies. The latter was accomplished toward the end of the contract when Dr. James Hurrell, then a Ph.D. candidate, successfully ported the NASA GLA general circulation model (GCM) to Purdue University. In our present grant, we have expanded our previous research to include studies of other convectively-driven circulation systems in the tropics besides the SPCZ. Furthermore, we have continued to examine the relationship between these convective systems and global-scale circulation patterns. Our recent research efforts have focused on three objectives: (1) determining the periodicity of large-scale bands of organized convection in the tropics, primarily synoptic to intraseasonal time scales in the Southern Hemisphere; (2) examining the relative importance of tropical versus mid-latitude forcing for Southern Hemisphere summertime subtropical jets, particularly over the Pacific Ocean; and (3) estimating tropical precipitation, especially over oceans, using observational and budget methods. A summary list of our most significant accomplishments in the past year is given. Author

N93-20093*# Texas A&M Univ., College Station. Dept. of Meteorology.

TROPICAL PACIFIC MOISTURE VARIABILITY

James P. McGuirk *In* NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 81-83 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

The research objectives are the following: (1) to describe synoptic scale variability of moisture over the tropical Pacific Ocean and the systems leading to this variability; (2) to implement satellite analysis procedures to accomplish (1); (3) to incorporate additional satellite information into

operational analysis/forecast systems at NMC; and (4) to synthesize knowledge gained from satellite observations through diagnosis and numerical models. Significant accomplishments in FY 91/92 are presented and include the following: (1) satellite forecast applications; (2) satellite data analysis; and (3) tropical plume mechanisms. Author

N93-20094*# Wisconsin Univ., Madison. Cooperative Inst. for Meteorological Satellite Studies.

INVESTIGATION OF CLOUD/WATER VAPOR MOTION WINDS FROM GEOSTATIONARY SATELLITE

Steve Nieman, Chris Velden, Kit Hayden, and Paul Menzel *In* NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 85-87 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

Work has been primarily focussed on three tasks: (1) comparison of wind fields produced at MSFC with the CO2 autowind/autoeditor system newly installed in NESDIS operations; (2) evaluation of techniques for improved tracer selection through use of cloud classification predictors; and (3) development of height assignment algorithm with water vapor channel radiances. The contract goal is to improve the CIMSS wind system by developing new techniques and assimilating better existing techniques. The work reported here was done in collaboration with the NESDIS scientists working on the operational winds software, so that NASA funded research can benefit NESDIS operational algorithms. Author

N93-20095*# Colorado State Univ., Fort Collins. Dept. of Electrical Engineering.

MICROWAVE RADIATIVE TRANSFER STUDIES OF PRECIPITATION

V. N. Bringi, J. Vivekanandan (National Center for Atmospheric Research, Boulder, CO.), and F. Joseph Turk *In* NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 89-90 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

Since the deployment of the DMSP SSM/I microwave imagers in 1987, increased utilization of passive microwave radiometry throughout the 10 - 100 GHz spectrum has occurred for measurement of atmospheric constituents and terrestrial surfaces. Our efforts have focused on observations and analysis of the microwave radiative transfer behavior of precipitating clouds. We have focused particular attention on combining both aircraft and SSM/I radiometer imagery with ground-based multiparameter radar observations. As part of this and the past NASA contract, we have developed a multi-stream, polarized radiative transfer model which incorporates scattering. The model has the capability to be initialized with cloud model output or multiparameter radar products. This model provides the necessary 'link' between the passive microwave radiometer and active microwave radar observations. This unique arrangement has allowed the brightness temperatures (TB) to be compared against quantities such as rainfall, liquid/ice water paths, and the vertical structure of the cloud. Quantification of the amounts of ice and water in precipitating clouds is required for understanding of the global energy balance. CASI

N93-20096*# Kansas Univ. Center for Research, Inc., Lawrence. Radar Systems and Remote Sensing Lab.

A SATELLITE-BORNE RADAR WIND SENSOR (RAWS)

Richard K. Moore, Michael Stuart, and Timothy Propp *In* NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 91-93 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

Modeling global atmospheric circulations and forecasting the weather would improve if worldwide information on winds aloft were available. Accurate prediction of weather is important to agriculture, shipping, air traffic, and many other fields. Global system models of climate are of great importance. Current global atmospheric models use pressure measurements and thermodynamic properties to calculate the effects of wind for use in Numerical Weather Prediction (NWP) models. Inputs to the NWP models are temperature, pressure and wind velocities at different heights. Clearly direct wind measurements could significantly improve the NWP model performance. The RAdar Wind Sounder (RAWS) program at the University of Kansas is a study of the feasibility and the trade-offs in the design of a space-based radar system to measure wind vectors. This can be done by measuring the Doppler shift of cloud and rain returns from three or more points and calculating the components of the wind vector. The RAWS study to date uses the candidate system selected after preliminary study of frequencies and sensitivities. Two frequencies chosen, 10 and 35 GHz, allow higher sensitivity for clouds and more penetration for rain. The past year was devoted to modeling the signal-to-noise ratio (SNR) achievable for the two frequencies. The determination of SNR versus cloud penetration depth used a cloud backscattering and attenuation model in the appropriate radar equation. Calculations assumed reasonable losses in reception and transmission, in addition to the atmospheric attenuation. We discovered that ice clouds provide a higher SNR than previously calculated, but some water clouds give lower SNRs than we calculated before. One of the primary issues in the SNR calculation was the choice of the drop size distribution. Although Xin used several distributions (e.g., log normal, Khrigian and Mazin), this year we used the Deirmendjian cloud model. SNR versus cloud penetration plots were generated to validate the candidate system. Rain, which appears in the cloud models at the lower altitudes, provides ample SNR, as do the higher clouds composed of ice particles. However, in some cloud situations we found the sensitivity for the clouds was marginal or inadequate. At 35 GHz, two of the cloud models characterized by 1 to 2 g/cu m of water content at altitudes extending from 150 to 1500 meters, produced a sufficient SNR. Other models, however, with water contents ranging from 0.5 to 4 g/cu m and altitudes up to 4000 meters, exhibit SNR of -3 to -23 dB, largely because of attenuation in the upper cloud layers. These results coupled with the lower SNR at 10 GHz, led to an investigation of alternate frequencies. The rain present beneath these clouds provides adequate SNR at 10 GHz, and in most cases, at GHz. Author

N93-20097*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

MAMS: HIGH RESOLUTION ATMOSPHERIC/SURFACE PROPERTIES

Gary J. Jedlovec, Anthony R. Guillory, Grant S. Carlson (Universities Space Research Association, Huntsville, AL.), and Robert J. Atkinson (General Electric Co., Huntsville, AL.) *In its* NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 95-97 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

The Multispectral Atmospheric Mapping Sensor (MAMS) has been used for a number of investigations over the last 8 years. It has served as the basis for retrieval technique development, for atmospheric process studies, and to retrieve geophysical parameters at the surface (land and ocean). It was used most recently to collect high resolution visible and infrared imagery for the CaPE and STORMFEST experiments during FY91 and FY92. The Wildfire spectrometer (similar to MAMS but with different infrared channels) was also used during STORMFEST. The goals of MAMS during CaPE were: (1) to collect MAMS data to support the overall CaPE science objectives; (2) refine techniques for the retrieval of atmospheric moisture and surface geophysical parameters; (3) map the moisture distributions associated with the sea breeze front over Florida with MAMS ancillary satellite data on a case study basis; (4) identify surface features which may serve as local sources of heat and moisture and influence preferential convective regions over Florida, and (5) process MAMS data and derived relevant geophysical parameters to support other CaPE investigators. For STORMFEST both the MAMS and Wildfire spectrometers were used to collect unique multispectral data to study atmospheric processes. The Wildfire objectives were: (1) to collect high quality Wildfire data in conjunction with other in situ and remote measurements available during the STORMFEST field phase (1 February - 15 March 1992); (2) to develop algorithms to retrieve total ozone content and compare with those from TOMS and HIRS (IR); and (3) along with water vapor imagery, use the ozone data to better understand the 3-dimensional structure and dynamics of jet streaks and frontal systems in a case study investigation. The MAMS objectives were: (1) collect MAMS data to support a GSFC investigation of gravity waves; and (2) process the MAMS data to locate gravity wave features, and produce various moisture products in support of the gravity wave investigation. The research activities over the last year are presented and they focused on analyzing the CaPE data sets and collecting and starting preliminary analysis of the STORMFEST MAMS and Wildfire data. CASI

N93-20098*# National Oceanic and Atmospheric Administration, Boulder, CO.

INFRARED BACKSCATTER CLIMATOLOGY AND MACAWS

M. J. Post *In* NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 99-101 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

During FY91 NOAA's research activities funded under NASA's RTOP program were centered on two areas: (1) infrared backscatter climatology; and (2) MACAWS. Derived from text

N93-20099*# Arizona Univ., Tucson.

MOUNTAIN TOP MEASUREMENTS OF BETA(9.2 MICRONS)

Richard M. Schotland *In* NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 103-105 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

The purpose of this program is to obtain statistical information on the variability of Beta(9.2 microns) in clean air on mountain top locations. Accomplishments in the past year are presented and involve the C.W. CO2 Homodyne Lidar and the Lidar Signal processor. Author

N93-20100*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

DEVELOPMENT OF A 100 mJ, 5 Hz, FLASHLAMP-PUMPED, Cr,Tm:YAG COHERENT LIDAR TRANSMITTER c36

S. Henderson (Coherent Technologies, Inc., Boulder, CO.) and S. Johnson *In its* NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 107 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

A contract to develop a 100 mJ, 5 Hz, flashlamp-pumped Cr,Tm:YAG coherent lidar transmitter has been awarded to Coherent Technologies, Inc. (CTI). The lidar transmitter will operate at an eyesafe wavelength of 2.01 microns. The development complements work being performed under an SBIR Phase II with Electro-Optics Technology (EOT). EOT is developing continuous wave, low and medium power Tm:YAG oscillators of a unique design. One of the low power oscillators will be used as the injection seeder/local oscillator in the CIT lidar transmitter. The lidar transmitter will require the addition of a receiver section. Once completed, the lidar will be used in atmospheric performance studies, allowing comparison with that of the more mature CO2 lidar technology. The focus of current research and plans for next year are presented. Author

N93-20101*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

MULTI-CENTER AIRBORNE COHERENT ATMOSPHERIC WIND SENSOR (MACAWS) c36

Jeffry Rhothermel, W. D. Jones, J. A. Dunkin, and E. W. McCaul, Jr. (Universities Space Research Association, Huntsville, AL.) *In its* NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 109-110 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

This effort involves development of a calibrated, pulsed coherent CO2 Doppler lidar, followed by a carefully-planned and -executed program of multi-dimensional wind velocity and aerosol backscatter measurements from the NASA DC-8 research aircraft. The lidar, designated as the Multi-center Airborne Coherent Atmospheric Wind Sensor (MACAWS), will be applicable to two research areas. First, MACAWS will enable specialized measurements of atmospheric dynamical processes in the planetary boundary layer and free troposphere in geographic locations and over scales of motion not routinely or easily accessible to conventional sensors. The proposed observations will contribute fundamentally to a greater understanding of the role of the mesoscale, helping to improve predictive capabilities for mesoscale phenomena and to provide insights into improving model parameterizations of sub-grid scale processes within large-scale circulation models. As such, it has the potential to contribute uniquely to major, multi-institutional field programs planned for the mid 1990's. Second, MACAWS measurements can be used to reduce the degree of uncertainty in performance assessments and algorithm development for NASA's prospective Laser Atmospheric Wind Sounder (LAWS), which has no space-based instrument heritage. Ground-based lidar measurements alone are insufficient to address all of the key issues. To minimize costs, MACAWS is being developed cooperatively by the lidar remote sensing groups of the Jet Propulsion Laboratory, NOAA Wave Propagation Laboratory, and MSFC using existing lidar hardware and manpower resources. Several lidar components have already been exercised in previous airborne lidar programs (for example, MSFC Airborne Doppler Lidar System (ADLS) used in 1981,4 Severe Storms Wind Measurement Program; JPL Airborne Backscatter Lidar Experiment (ABLE) used in 1989,90 Global Backscatter Experiment Survey Missions). MSFC has been given responsibility for directing the overall program of instrument development and scientific measurement. The focus of current research and plans for next year are presented. Author

N93-20102*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

AEROSOL CHEMISTRY IN GLOBE

Antony D. Clarke (Hawaii Univ., Honolulu.), Jeffry Rothermel, and Maurice A. Jarzembski *In its* NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 111 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

This task addresses the measurement and understanding of the physical and chemical properties of aerosol in remote regions that are responsible for aerosol backscatter at infrared wavelengths. Because it is representative of other clean areas, the remote Pacific is of extreme interest. Emphasis is on the determination size dependent aerosol properties that are required for modeling backscatter at various wavelengths and upon those features that may be used to help understand the nature, origin, cycling and climatology of these aerosols in the remote troposphere. Empirical relationships will be established between lidar measurements and backscatter derived from the aerosol microphysics as required by the NASA Doppler Lidar Program. This will include the analysis of results from the NASA GLOBE Survey Mission Flight Program. Additional instrument development and deployment will be carried out in order to extend and refine this data base. Identified activities include participation in groundbased and airborne experiments. Progress to date includes participation in, analysis of, and publication of results from Mauna Loa Backscatter Intercomparison Experiment (MABIE) and Global Backscatter Experiment (GLOBE). Author

N93-20103*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

CO2 LIDAR BACKSCATTER EXPERIMENT

Maurice A. Jarzembski, Jeffry Rothermel, David A. Bowdle (Alabama Univ., Huntsville.), Vandana Srivastava (Universities Space Research Association, Huntsville, AL.), Dean Cutten (Alabama Univ., Huntsville.), and Eugene W. McCaul, Jr. (Universities Space Research Association, Huntsville, AL.) *In its* NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 113-116 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

The Aerosol/Lidar Science Group of the Remote Sensing Branch engages in experimental and theoretical studies of atmospheric aerosol scattering and atmospheric dynamics, emphasizing Doppler lidar as a primary tool. Activities include field and laboratory measurement and analysis efforts by in-house personnel, coordinated with similar efforts by university and government institutional researchers. The primary focus of activities related to understanding aerosol scattering is the GLObal Backscatter Experiment (GLOBE) program. GLOBE was initiated by NASA in 1986 to support the engineering design, performance simulation, and science planning for the prospective NASA Laser Atmospheric Wind Sounder (LAWS). The most important GLOBE scientific result has been identified of a background aerosol mode with a surprisingly uniform backscatter mixing ratio (backscatter normalized by air density) throughout a deep tropospheric layer. The backscatter magnitude of the background mode evident from the MSFC CW lidar measurements is remarkably similar to that evident from ground-based backscatter profile climatologies obtained by JPL in Pasadena CA, NOAA/WPL in Boulder CO, and by the Royal Signals and Radar Establishment in the United Kingdom. Similar values for the background mode have been inferred from the conversion of in situ aerosol microphysical measurements to backscatter using Mie theory. Little seasonal or hemispheric variation is evident in the survey mission data, as opposed to large variation for clouds, aerosol plums, and the marine boundary layer.

Additional features include: localized aerosol residues from dissipated clouds, occasional regions having mass concentrations of nanograms per cubic meter and very low backscatter, and aerosol plumes extending thousands of kilometers and several kilometers deep. Preliminary comparison with meteorological observations thus far indicate correlation between backscatter and water vapor under high humidity conditions. Limited intercomparisons with the Stratospheric Aerosol and Gas Experiment (SAGE) limb extinction sounder shows differences in the troposphere, however, it should be noted that in general SAGE measurements have not yet been validated in the troposphere. Derived from text

N93-20104*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

SIMULATIONS OF SATELLITE DOPPLER WIND OBSERVATIONS

George D. Emmitt (Simpson Weather Associates, Inc., Charlottesville, VA.), S. A. Wood (Simpson Weather Associates, Inc., Charlottesville, VA.), L. S. Wood (Simpson Weather Associates, Inc., Charlottesville, VA.), and O. Vaughan *In its* NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 117-118 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

This study will involve two objectives: (1) to develop, through computer simulations, optimal satellite-based sensor scanning techniques for direct measurement of tropospheric winds on the meso- and synoptic scales; and (2) to construct simulations of remotely measured wind fields for assessing impact of such fields on the diagnosis and prognosis of atmospheric phenomena through the use of Observing System Simulation Experiments (OSSE). Using the LAWS Simulation Model (LSM), various global coverage scenarios have been investigated as part of an effort to define the optimal orbit, configuration and sampling strategies for observations of winds for use in global circulation models. Simulated data sets have been provided to GSFC, FSU and several LAWS team members. Particular emphasis has been on providing realistic cloud cover, cirrus backscatter, aerosol distribution and wind variance on scales less than 600 km. Progress is currently being made to incorporate other remote sensors (AIRS/AMSU, STIKSCAT) into the global OSSEs.

Derived from text

N93-20105*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

A MODELING STUDY OF MARINE BOUNDARY LAYER CLOUDS

Shouping Wang (Universities Space Research Association, Huntsville, AL.) and Daniel E. Fitzjarrald *In its* NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 119-120 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

Marine boundary layer (MBL) clouds are important components of the earth's climate system. These clouds drastically reduce the amount of solar radiation absorbed by the earth, but have little effect on the emitted infrared radiation on top of the atmosphere. In addition, these clouds are intimately involved in regulating boundary layer turbulent fluxes. For these reasons, it is important that general circulation models used for climate studies must realistically simulate the global distribution of the MBL. While the importance of these cloud systems is well recognized, many physical processes involved in these clouds are poorly understood and their representation in large-scale models remains an unresolved problem. The present research aims at the development and improvement of the parameterization of these cloud systems and an understanding of physical processes involved. This goal is addressed in two ways. One is to use regional modeling approach to validate and evaluate two-layer marine boundary layer models using satellite and ground-truth observations; the other is to combine this simple model with a high-order turbulence closure model to study the transition processes from stratocumulus to shallow cumulus clouds. Progress made in this effort is presented.

Derived from text

N93-20106*# Alabama Univ., Huntsville. Center for Applied Optics.

COMPUTER MODELING OF PULSED CO2 LASERS FOR LIDAR APPLICATIONS **c36**

Gary D. Spiers *In* NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 121-124 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

The object of this effort is to develop code to enable the accurate prediction of the performance of pulsed transversely excited (TE) CO2 lasers prior to their construction. This is of particular benefit to the NASA Laser Atmospheric Wind Sounder (LAWS) project. A benefit of the completed code is that although developed specifically for the pulsed CO2 laser much of the code can be modified to model other laser systems of interest to the lidar community. A Boltzmann equation solver has been developed which enables the electron excitation rates for the vibrational levels of CO2 and N2, together with the electron ionization and attachment coefficients to be determined for any CO2 laser gas mixture consisting of a combination of CO2, N2, CO, He and CO. The validity of the model has been verified by comparison with published material. The results from the Boltzmann equation solver have been used as input to the laser kinetics code which is currently under development. A numerical code to model the laser induced medium perturbation (LIMP) arising from the relaxation of the lower laser level has been developed and used to determine the effect of LIMP on the frequency spectrum of the LAWS laser output pulse. The enclosed figures show representative results for a laser operating at 0.5 atm. with a discharge cross-section of 4.5 cm to produce a 20 J pulse with aFWHM of 3.1 microns. The first four plots show the temporal evolution of the laser pulse power, energy evolution, LIMP frequency chirp and electric field magnitude. The electric field magnitude is taken by beating the calculated complex electric field and beating it with a local oscillator signal. The remaining two figures show the power spectrum and energy distribution in the pulse as a function of the varying pulse frequency. The LIMP theory has been compared with experimental data from the NOAA Windvan Lidar and has been found to be in good agreement.

Derived from text

N93-20107*# Florida State Univ., Tallahassee. Dept. of Meteorology.

REMOTE SENSING OF WATER VAPOR FEATURES

Henry E. Fuelberg *In* NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 125-127 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

Water vapor plays a critical role in the atmosphere. It is an important medium of energy exchange between air, land, and water; it is a major greenhouse gas, providing a crucial radiative role in the global climate system; and it is intimately involved in many regional scale atmospheric processes. Our research has been aimed at improving satellite remote sensing of water vapor and better understanding its role in meteorological processes. Our early studies evaluated the current GOES VAS system for measuring water vapor and have used VAS-derived water vapor data to examine pre-thunderstorm environments. Much of that research was described at the 1991 Research Review. A second research component has considered three proposed sensors--the High resolution Interferometer Sounder (HIS), the Multispectral Atmospheric Mapping Sensor (MAMS), and the Advanced Microwave Sounding Unit (AMSU). We have focused on MAMS and AMSU research during the past year and the accomplishments made in this effort are presented. Derived from text

N93-20108*# Wisconsin Univ., Madison. Cooperative Inst. for Meteorological Satellite Studies.

AN INVESTIGATION OF THE ROLE OF CURRENT AND FUTURE REMOTE SENSING DATA SYSTEMS IN NUMERICAL METEOROLOGY

George R. Diak and William L. Smith *In* NASA. Marshall Space Flight Center, NASA/MSFC FY92 Earth Science and Applications Program Research Review Jan. 1993 p 129-133 (For primary document see N93-20067 07-47)

Avail: CASI HC A01/MF A02

The goals of this research endeavor have been to develop a flexible and relatively complete framework for the investigation of current and future satellite data sources in numerical meteorology. In order to realistically model how satellite information might be used for these purposes, it is necessary that Observing System Simulation Experiments (OSSEs) be as complete as possible. It is therefore desirable that these experiments simulate in entirety the sequence of steps involved in bringing satellite information from the radiance level through product retrieval to a realistic analysis and forecast sequence. In this project we have worked to make this sequence realistic by synthesizing raw satellite data from surrogate

atmospheres, deriving satellite products from these data and subsequently producing analyses and forecasts using the retrieved products. The accomplishments made in 1991 are presented. The emphasis was on examining atmospheric soundings and microphysical products which we expect to produce with the launch of the Advanced Microwave Sounding Unit (AMSU), slated for flight in mid 1994. Derived from text

N93-20278 Wisconsin Univ., Madison.
A COMPARISON OF INTENSE EXTRATROPICAL CYCLONE LIFE CYCLES FROM DIVERSE GEOGRAPHICAL LOCATIONS Ph.D. Thesis
Russell Stephen Schneider 1992 253 p
Avail: Univ. Microfilms Order No. DA9224177

The complete life cycles of eleven intense wintertime extratropical cyclones from diverse oceanic and continental regions were studied to determine their systematic regional characteristics. In addition, the influence of intense cyclones on the water vapor and kinetic energy balance of the extratropics was examined. To accomplish these objectives, storm-relative (quasi-Lagrangian) mass, water vapor, kinetic energy, static stability, and angular momentum diagnostics (Johnson and Downey 1975a, b; 1976) were evaluated for each cyclone using ECMWF FGGE-IIIB Final Analysis data. The cyclone water vapor and kinetic energy balances were compared to similar diagnostics for a global domain. The results indicate that the distribution of northern hemisphere cold continental landmasses and warm ocean currents exerts a pervasive influence on the regional characteristics of wintertime extratropical cyclones. In most oceanic cyclones, strong surface sensible and latent heat fluxes contribute to weak static stability, strong water vapor convergence, intense latent heat release, and life cycles of long duration. As a result, relatively small oceanic cyclones have a dominant impact on the northern hemisphere wintertime extratropical hydrologic cycle, heat balance, and kinetic energy balance. With the importance of the atmospheric component of the global hydrologic cycle to the energy balance of the entire Earth System, the 5 day residence time for extratropical water vapor, and the nonlinearity associated with intense latent heat release, successful modeling of the water vapor balance in these wintertime oceanic cyclones is essential for successful medium and long-range numerical predictions. Dissert. Abstr.

N93-20280 Toronto Univ. (Ontario).
A NUMERICAL INVESTIGATION OF SQUALL LINES Ph.D. Thesis
Kit Kong Szeto 1991 191 p
(ISBN-0-315-69244-8) Avail: Univ. Microfilms Order No. DANN69244

A two-dimensional, anelastic, cloud-resolving numerical model was used to simulate squall systems. Large domain and fine grid resolutions were utilized so that both the convective and mesoscale components of squall lines could be handled adequately by the model. Both the life-cycle and storm structure of the simulated squall lines compare favorably to observed systems. New insights in squall line dynamics were obtained through systematic sensitivity experiments and careful analysis of results. In particular, the interactions between convection, low-level cold outflows and ambient shear has been examined. It was found that the temporal evolution of squall lines could be controlled by its internal dynamics. Mechanisms responsible for the initiation and maintenance of the mesoscale circulation (and the associated stratiform precipitation) have been investigated. The mesoscale updraft was found to be a consequence of the destabilization of the upper-troposphere by detrainments of heat and moisture from the cumulonimbus and mesoscale convergence at the mid-levels. The inclusion of ice-phase microphysics has been found to be important in simulating the realistic precipitation and kinematic features of squall systems. Experiments performed with the Coriolis force neglected produced systems with stronger horizontal flows and consequently wider trailing stratiform precipitation region. This result suggests a plausible explanation for the usually observed wider stratiform regions associated with tropical mesoscale convective systems than their mid-latitude counterparts. Dissert. Abstr.

N93-20281 Washington Univ., Saint Louis, MO.
ON THE SIZE DEPENDENCE OF THE CHEMICAL PROPERTIES OF CLOUD DROPLETS: EXPLORATORY STUDIES BY AIRCRAFT Ph.D. Thesis
Cynthia H. Twohy 1992 250 p
Avail: Univ. Microfilms Order No. DA9239511

Clouds play an important role in the climate of the earth and in the transport and transformation of chemical species, but many questions about clouds remain unanswered. In particular, the chemical properties of droplets may vary with droplet size, with potentially important consequences. The counterflow virtual impactor (CVI) separates droplets from interstitial particles and gases in a cloud and also can collect droplets in discrete size ranges. As such, the CVI is a useful tool for investigating the chemical components present in droplets of different sizes and their potential interactions with cloud processes. The purpose of this work is twofold. First, the sampling characteristics of the airborne CVI are investigated, using data from a variety of experiments. A thorough understanding of CVI properties is necessary in order to utilize the acquired data judiciously and effectively. Although the impaction characteristics of the CVI seem to be predictable by theory, the airborne instrument is subject to influences that may result in a reduced transmission efficiency for droplets, particularly if the inlet is not properly aligned. Ways to alleviate this problem are being investigated, but currently the imperfect sampling efficiency must be taken into account during data interpretation. Relationships between the physical and chemical properties of residual particles from droplets collected by the CVI and droplet size are then explored in both stratiform and cumulus clouds. The effects of various cloud processes and measurement limitations upon these relationships are discussed. In one study, chemical analysis of different-sized droplets sampled in stratiform clouds showed a dependence of chemical composition on droplet size, with larger droplets containing higher proportions of sodium than non-sea-salt sulfate and ammonium. Larger droplets were also associated with larger residual particles, as expected from simple cloud nucleation theory. In a study of marine cumulus clouds, the CVI was combined with a cloud condensation nucleus spectrometer to study the supersaturation spectra of residual particles from droplets. The median critical supersaturation of the droplet residual particles was consistently less than or equal to the median critical supersaturation of ambient particles except at cloud top, where residual particles exhibited a variety of critical supersaturations. Dissert. Abstr.

N93-20360# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
SATELLITE DERIVED RAINFALL AND THE INTENSITY OF TROPICAL CYCLONES AND POSSIBLE RELATIONSHIPS TO SEA SURFACE TEMPERATURE M.S. Thesis
Timothy D. Hutchison 1992 91 p
(AD-A258573; AFIT/CI/CIA-92-106) Avail: CASI HC A05/MF A01

This research used a nonlinear algorithm developed by Olson, et al. (1989) to retrieve rainrates from satellite derived microwave brightness temperatures for tropical cyclones over tropical oceanic regions, These derived rainrates were used to determine the total 24 hour rainfall and subsequent, amount of energy generated via latent heat release for eight cases. The results showed good agreement with previous results and indicate that the SSM/I is a useful tool in assessing the total amount of rainfall of a tropical cyclone over oceanic regions. The derived rainrates were used to determine total rainfall, total convective rainfall and total stratiform rainfall. These were correlated with surrounding sea surface temperatures. Results indicate there is only a weak correlation between sea surface temperatures and the convective, stratiform and total rainfall. This supports previous findings regarding the highly complex nature of tropical cyclones and the nonlinearity of the numerous predictors. Stronger correlations were found between the surface temperature variance and rainfall indicating that the temperature contrast may be more important in determining rainfall than the actual temperatures. Significantly stronger relationships were identified between sea surface temperature and storm intensity. Strong correlations were found between SST's surrounding the storm and the future intensity. The most significant relationship was found for the outer regions and the intensity 24-48 hours later which agrees with the 1-2 day lag between convective bursts and intensification. It seems apparent that SST's play a critical role in this process, although the specific mechanism is not known. GRA

N93-20586# Science Applications International Corp., McLean, VA.
JOINT TYPHOON WARNING CENTER (JTWC92) MODEL Final Report
R. E. Englebretson May 1992 98 p
(Contract N00014-90-C-6042; DA Proj. X05-23)
(AD-A258646; NOARL-CR-028-92) Avail: CASI HC A05/MF A02

The Joint Typhoon Warning Center JTWC92 model for the prediction of tropical cyclone motion was developed by Science Applications International Corporation (SAIC), Division 425, Monterey, CA. The project was performed in three phases: database development, model development, and model

testing and implementation. The period of performance was September 15, 1989 through July 23, 1992. Progress was interrupted between and within phases due to the incremental nature of funding. Total funding for the program was $207,102, with $49,275 for database development and a total of $157,828 for the last two phases. GRA

N93-20607# South Dakota School of Mines and Technology, Rapid City. Inst. of Atmospheric Sciences.
[ACTIVITIES OF SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY] Annual Technical Report, 1 Jul. 1991 - 30 Sep. 1992
30 Sep. 1992 8 p
(Contract N00014-91-J-4017)
(AD-A259282) Avail: CASI HC A02/MF A01

The primary objectives of the research are to numerically simulate stratus, stratocumulus, and cumulus clouds in the marine boundary layer. This will include the formation, evolution, and dissolution of the clouds and the area covered by the cloud fields. If a large enough domain can be covered, then the change from one type of cloud to another would be investigated. Also the change from open cell to closed cell type convection and the formation of cloud streets could be investigated. Another objective is to increase our understanding of conditions in the marine boundary layer. What determines the vertical profiles of humidity, temperature, and cloud characteristics in space and time? What causes the changing depth of the boundary layer? What are its interaction with the clouds in and out of the boundary layer? A third objective is to compare various numerical models among themselves and with observations. GRA

N93-20609# Air Force Inst. of Tech., Wright-Patterson AFB, OH. Foreign Aerospace Science and Technology Center.
MANUAL ON CLIMATE OF THE USSR. ISSUE 16: ARMENIAN SSR. PART 5: CLOUD COVER AND ATMOSPHERIC PHENOMENA-TRANSLATION [SPRAVOCHNIK PO KLIMATU SSSR, PART 5, NR. 16]
18 Nov. 1992 323 p Transl. into ENGLISH from Spravochnik po Klimatu SSSR, part 5, number 16 (Leningrad, Russia, Gidrometerologicheskoye), 1969 p 1-24; 24A; 25-36; 36A; 37-42: 42A; 43-180
(AD-A259288; FASTC-ID(RS)T-0838-92-Pt-5) Avail: CASI HC A14/MF A03

In issue 16, part 5 of the Manual, a short characterization of the conditions of cloud cover and atmospheric phenomena in the territory of the Armenian SSR is given. Part 5 consists of five sections: Section 1--Thunderstorms, Section 2--Fog, Section 3--Snow storms, Section 4--Thunderstorms, and Section 5--Hail storms. The data within all sections were processed within the limits of the period 1936-1965. The exception is section 5, for which the data were processed for the years 1891-1965. GRA

N93-20887# Institut Royal Meteorologique de Belgique, Brussels.
GUST FORECASTING [LA PREVISION DES RAFALES]
A. Quinet and J. Nemeghaire 1991 57 p In FRENCH
(Misc-SER-A-125; ETN-93-92993) Avail: CASI HC A04/MF A01

The hypothesis that in intense turbulent mixing conditions, the maximum gust results from the deflection up to the ground of air streams flowing at the top of the Surface Boundary Layer (SBL), is presented. The main steps of the neutral SBL theory are outlined and it is noticed that for a site, such as the meteorological station at Uccle (Belgium), the base of the SBL is at a height of 100 m. Since 1 Jan. 1990 a new radiosounding system in Uccle has given an adequate resolution of the SBL configuration. Twenty nine case studies were distributed into three classes based on wind or temperature profiles. The first class is characterized by a typical logarithmic wind and neutral thermal profile. In a second class case studies where the wind profile is influenced by a stable thermal stratification were gathered together. A third category concerned the situations where the free convection level is located in the turbulent mixing layer. The forced convection switches then to free convection and the mixing affects a largely thicker layer than the characteristic SBL. In all case studies, the observations, and the above mentioned hypothesis are consistent. ESA

N93-20888# Institut Royal Meteorologique de Belgique, Brussels.
NOCTURNAL TEMPERATURE FORECASTING [LA PREVISION DES TEMPERATURES NOCTURNES]
J. vanderBorght and A. Quinet 1992 43 p In FRENCH
(Misc-SER-A-126; ETN-93-92994) Avail: CASI HC A03/MF A01

A method to forecast nocturnal temperatures, which individually considers the diverse physical processes which contribute to marked falls in night temperature, is described. Large falls in temperature occur either when polar air arrives directly after the passage of a cold front, or in conjunction with a weak wind in a clear atmosphere, especially when the global contents of water vapor in the column above the site is small. The latter is often associated with anticyclones. Hybrid situations are also possible. The analysis described is more relevant to the second category. The analysis takes into account: the radiative transfer in clear atmosphere during the night; vertical transfer of ground heat; and, to a small extent, because the winds are generally weak, turbulent transfer following the vertical. The calculation of these variables is shown. The effects of large scale advection and of oceanic effects are ignored. ESA

N93-21010# Ecole Centrale de Lyon (France). Lab. de Mecanique des Fluides et d'Acoustique.
CONTRIBUTION TO THE STUDY OF THE ATMOSPHERIC SURFACE LAYER IN STABLE CONDITIONS, SIMULATED IN A WIND TUNNEL Ph.D. Thesis [CONTRIBUTION A L'ETUDE DE LA COUCHE DE SURFACE ATMOSPHERIQUE, EN SITUATION STABLE, SIMULEE EN SOUFFLERIE]
Rabah Zegadi 1991 187 p In FRENCH
(ECL-91-15; ETN-93-91953) Avail: CASI HC A09/MF A02

The atmospheric surface layer in thermally stratified stable conditions is simulated for the cases of smooth and rough wall, in an attempt to analyze the effects of such a stratification on the turbulent characteristics of the flow. The experimental device and the measurement techniques are described. The smooth and rough cases are compared, and experimental results are given for three degrees of stability obtained in smooth wall. The theory of Monin and Obukhov is tested on rough wall in stable and neutral conditions. The results obtained for the smooth case, for a degree of stability defined by the global Richardson number 0.13 with a k-epsilon model adapted to flows submitted to the force of gravity, are compared. ESA

N93-21014# Woods Hole Oceanographic Inst., MA. Hydrographic Programme Office.
WORLD OCEAN CIRCULATION EXPERIMENT: DATA SUMMARY OF JAPAN METEOROLOGICAL AGENCY SURVEYS ALONG 137 DEG E (1967-1988)
Terrence M. Joyce and Bo Qui Jun. 1992 152 p
(Grants NSF OCE-89-07815; NSF OCE-92-06184)
(PB92-219658; WHPO-92-2; WOCE-88/92) Avail: CASI HC A08/MF A02

A repeated hydrographic survey along the 137 deg E meridian in the western North Pacific has been performed by the Japan Meteorological Agency every winter since 1967 and every summer since 1972. This data summary provides an assessment of measurement error for temperature, salinity, and oxygen, a description of data quality control, and a regridding procedure in analyzing this hydrographic data set. Scientific studies based on these repeated observations and results of the objectively mapped distributions of temperature, salinity, and oxygen for the 39 cruises (1967-1988) are documented. Sampling of this hydrographic line is to be continued as a Japanese contribution to the WOCE Hydrographic Program (WHP); it has been given the designation PR2. GRA

N93-21040# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Abt. Wolkenphysik.
A DOCUMENTATION OF ICING-RELEVANT CLOUD-PHYSICAL PARAMETERS ON VERTICAL SOUNDINGS OF STRATIFORM CLOUDS (CONTINUATION) [EINE DOKUMENTATION VEREISUNGSRELEVANTER WOLKENPHYSIKALISCHER PARAMETER BEI VERTIKALSONDIERUNGEN STRATIFORMER WOLKEN (FORTSETZUNG)]
Hans-Eberhard Hoffmann and Johann Demmel Nov. 1991 101 p In GERMAN
(DLR-Mitt-91-19; ETN-93-91919) Avail: CASI HC A06/MF A02; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

The results of twenty further vertical soundings were arranged, according to the synoptic conditions. In Sc, St cloudiness of a high pressure area, the Total Water Content (TWC) generally increased with growing distance from the cloud base. It reached its maximum (0.18 to 0.48 g/cu m) in the middle or immediately beneath the cloud top. The temperature gradient had values between -0.4 and 0.8 per 100 m. The Median Volume Diameter (MVD) had mainly small values, between 3 and 20 micrometers. In Sc, Ac, As, and Ns, cloudiness in the range of cold or warm fronts or in a flow from variable direction, the maximum values of the TWC were between 0.10 and 1.10 g/m, and those of MVD up to 600 micrometers. The temperature gradient had values between -0.3 and -0.8 C per 100 m.
ESA

N93-21200# National Weather Service, Salt Lake City, UT. Scientific Services Div.
CLIMATE OF SALT LAKE CITY, UTAH
Wilbur E. Figgins, Alexander R. Smith, Craig C. Schmidt, and James A. Cisco Jul. 1992 95 p Revised
(PB92-228402; NOAA-TM-NWS-WR-152) Avail: CASI HC A05/MF A01
The purpose of the publication is an attempt to bring together under one cover as much data as possible concerning the climate of Salt Lake City. This was a difficult undertaking because of the wide variance of climate in the Salt Lake area. The Wasatch Mountain range, immediately east of the city, and the location of the Great Salt Lake, a short distance to the west, cause a great difference in local microclimates. The Salt Lake City weather records began over 100 years ago; however, the statistics in the report are based on the airport weather records which began May 1, 1928. The airport location continues to be the National Weather Service's official weather observing location for the Salt Lake City area. This provides us with over 64 years of continuous weather information that was observed from an existing or comparable exposure location.
GRA

N93-21202# National Oceanic and Atmospheric Administration, Boulder, CO. Forecast Systems Lab.
COHERENT INTERFERENCE TESTS FOR WIND PROFILERS
Rigoberto Munoz Diaz and Russell B. Chadwick Jun. 1992 87 p
(PB92-227248; NOAA-TM-ERL-FSL-3) Avail: CASI HC A05/MF A01
A coherent interference test for wind profilers is presented. The test determines whether or not coherent interference or 'changing' coherent interference is small enough to have negligible effect on profiler wind estimates. The test is based on velocity estimates made when the profiler received signal is white, Gaussian noise. These mean radial velocity estimates are uniform over the Nyquist interval, and their distribution can be tested using the chi square test of goodness-of-fit for random variables. Methods for short- and long-term tests are described. The long-term test is for uniformity of distribution in time while the short-term test is across different range gates.
GRA

N93-21227# National Weather Service, Fort Worth, TX. Southern Region.
METEOROLOGICAL EVENTS IN ARIZONA AND NEW MEXICO DURING SWAMP
Morris S. Webb, Jr. Oct. 1992 20 p
(PB93-100410; NOAA-TM-NWS-SR-142) Avail: CASI HC A03/MF A01
New Mexico's weather, like Arizona's, is influenced by the Southwest Monsoon. Indeed, the major part of Arizona's and New Mexico's warm-season rainfall usually occurs between 1 July and 15 September. This was particularly true in the monsoon season of 1990, when both states reported several severe thunderstorm and flash flood events. This study attempts to determine effects of the Southwest Monsoon on Arizona and New Mexico during the period from 14 June to 26 September 1990. Climatological data from both Mexico and the United States and severe storm reports from Arizona and New Mexico were the primary data sources used in this study. Results show that the percentage of locations having measurable precipitation in a 24-hour period was greater in New Mexico than in Arizona during the 1990 Southwest Monsoon. Also, there were more 'superpeak' days in New Mexico than in Arizona during the period of study. Possible reasons for the difference in precipitation frequency are addressed. Precipitation patterns present in Arizona and New Mexico during the monsoon season of 1990 are also shown.
GRA

N93-21228# National Hurricane Center, Coral Gables, FL.
HURRICANE EXPERIENCE LEVELS OF COASTAL COUNTY POPULATIONS FROM TEXAS TO MAINE, AUGUST 1992
Jerry D. Jarrel, Paul J. Hebert, and Max Mayfield Aug. 1992 158 p
(PB93-105971; NOAA-TM-NWS-NHC-46) Avail: CASI HC A08/MF A02
Population graphs for the period 1900-1990 have been prepared for coastal counties from Texas to Maine which could be affected significantly by hurricane winds or tides. The Saffir/Simpson Hurricane Scale (range 1-5) has been used to develop a hurricane climatology for each county for the period 1900-1990. The combined statistics graphically illustrate that about 85 percent of all Atlantic and Gulf coastal residents of the United States have never experienced the effects of a direct hit by a major hurricane.
GRA

N93-21229# National Oceanic and Atmospheric Administration, Boulder, CO. Forecast Systems Lab.
HYDROSTATICALLY CONSISTENT NORTH AMERICAN RADIOSONDE DATA BASE AT THE FORECAST SYSTEMS LABORATORY, 1946-PRESENT
Barry Schwartz and Mark Govett Aug. 1992 91 p
(PB93-112225; NOAA-TM-ERL-FSL-4) Avail: CASI HC A05/MF A01
A data base containing all known upper-air reports for North America has been created at the Forecast Systems Laboratory (FSL). Rawinsonde data acquired from various sources for the period 1946 to the present were subjected to gross error and hydrostatic consistency checks. The data base was created for two reasons: to satisfy a requirement to support ongoing case studies and climatological research with a conveniently accessible data base located at FSL, and to include data not contained in the data base residing at the National Climatic Data Center (NCDC). This Technical Memorandum describes the creation of the FSL data base and the quality control procedures used. It also includes the methods used to replace parts of the soundings that are missing from the NCDC data, a description of the data access routine, real-time updates to the data base, and station history and inventory information.
GRA

N93-21290# National Meteorological Center, Washington, DC.
A PROCEDURE TO REDUCE NORTHWARD DRIFT OF TROPICAL STORMS IN A NUMERICAL MODEL
Mukut B. Mathur and Alan M. Shapiro (University Corp. for Atmospheric Research, Boulder, CO.) Jul. 1992 36 p
(PB92-226406; NOAA-TM-NWS-NMC-71) Avail: CASI HC A03/MF A01
Operational primitive equation models often predict hurricane tracks that lie to the right of the observed motion. Such a bias in the National Meteorological Center's Quasi-Lagrangian Model (QLM) is most pronounced for the storms that moved westward. It is shown that a westward displacement of the storm's circulation in the initial analysis significantly contributes to this erroneous motion to the right of the observed track in the QLM. A procedure to reduce this bias for westward moving storms is presented. It consists of imposing a secondary circulation (a dipole) over the initial storm area. The cyclonic (anticyclonic) lobe of the dipole is centered to the south (north) of the observed track. The use of the dipole procedure resulted in a substantial improvement in the forecast track throughout the 72 hour period in several cases.
GRA

N93-21293# Office of Science and Technology, Washington, DC.
PREDICTING OUR WEATHER: A STRATEGIC PLAN FOR THE US WEATHER RESEARCH PROGRAM
Jul. 1992 50 p
(PB93-101277) Avail: CASI HC A03/MF A01
The report outlines a strategic plant to guide the planning and conduct of the U.S. Weather Research Program, which has been conceived to improve our nation's capability to forecast weather in the near future (1-48 hours). Our current inability to be site- and time-specific in developing forecasts of hazardous weather events costs our nation annually hundreds of lives, thousands of injuries, and billions of dollars in property damage and lost revenues. New weather observing technologies are not collecting detailed atmospheric data on a routine basis which has never before been available.
GRA

N93-21294# National Weather Service, Silver Spring, MD.
SELECTED WORLDWIDE MARINE WEATHER BROADCASTS

Sep. 1992 205 p Sponsored by Naval Oceanography Command
(PB93-118164) Avail: CASI HC A10/MF A03; SOD HC

The Selected Worldwide Marine Weather Broadcasts (SWMWB) publication contains information and schedules of marine weather broadcasts made primarily in the English language. Part 1 contains details of radiotelephone, radiotelegraph, and radioteleprinter transmissions. It is arranged by regions with countries listed in alphabetical order within the regions. Part 2 contains details of radiofacsimile transmissions and is a reprint of the most current Worldwide Marine Radiofacsimile Broadcast Schedules. For ease of use, all stations are listed initially by WMO region and then country and location in alphabetical order. GRA

N93-21367# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Abt. Wolkenphysik.

CAPACITIES OF THE DLR POLARIZATION DIVERSITY RADAR FOR DETERMINING ICING RELEVANT CLOUDPHYSICAL PARAMETERS [EINSATZMOEGLICHKEITEN DES DLR-POLARISATION-DIVERSITY-RADARS ZUR BESTIMMUNG VEREISUNGSRELEVANTER WOLKENPHYSIKALISCHER PARAMETER]

Heinrich Salbreiter Apr. 1991 99 p In GERMAN
(DLR-Mitt-91-14; ETN-93-91915) Avail: CASI HC A05/MF A02; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

The capacities of radar for improving the forecast of aircraft icing within stratiform clouds are studied. The sensitivity of the Polarization Diversity Radar (POLDIRAD) is estimated. A discussion on which of the icing relevant cloud physical parameters can be determined from polarization and doppler measurements is given. Additional investigation is recommended for widening and conforming actual measuring and analyzing methods. Medium termed estimations are expected to be possible for the icing parameters, liquid water content and particle phase, drop size distribution, ice particle type, and particle fraction of an ice water mixture in individual cases. POLDIRAD may give valuable assistance, in localizing icing relevant regions and estimating icing hazard. ESA

N93-21388# National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.

MEAN SEASONAL CYCLES AND INTERANNUAL VARIATIONS AT 0 DEG, 110 DEG W AND 0 DEG, 140 DEG W DURING 1980-1991

M. J. McPhaden and M. E. McCarty (Washington Univ., Seattle.) Aug. 1992 124 p Prepared in cooperation with Joint Institute for the Study of the Atmosphere and Ocean
(PB93-114726; NOAA-TM-ERL-PMEL-95; CONTRIB-1377) Avail: CASI HC A06/MF A02

The report summarizes current meter mooring data at 0, 110 W and 0, 140 W in terms of multi-year monthly mean time series and mean seasonal cycles. Data span the years 1980-1991 at 110 W and 1983-1991 at 140 W. The measurements consist of surface winds, air temperatures, ocean currents in the upper 250 m and ocean temperatures in the upper 500 m. GRA

N93-21450# World Meteorological Organization, Geneva (Switzerland). World Climate Data and Monitoring Programme.

THE GLOBAL CLIMATE SYSTEM. CLIMATE SYSTEM MONITORING Report No. 4, Dec. 1988 - May 1991

David Philips, B. M. Chhabra (Indian Meteorological Dept., New Delhi.), Georgii V. Gruza (Institute of Global Climate and Ecology, Moscow, Russia.), Richard Heim (National Oceanic and Atmospheric Administration, Asheville, NC.), Raino Heino (Finnish Meteorological Inst., Helsinki.), Philip Jones (East Anglia Univ., Norwich, England.), Bill Kininmonth (Bureau of Meteorology, Melbourne, Australia.), Vernon Kousky (Naval Oceanographic Office, Washington, DC.), Luiz Molion (Space Research Inst., Manaus, Brazil.), and Laban OGallo (Nairobi Univ., Kenya.) et al May 1991 108 p Original contains color illustrations
Avail: NTIS MF A06; print copy available at WMO, Geneva, Switzerland

The Climate System Monitoring (CSM) project of the World Climate Data and Monitoring Program (WCDMP) was initiated in 1984 following a recommendation of the Ninth Congress of the World Meteorological Organization (WMO) in response to the occurrence of significant climate system anomalies over the last few years associated with adverse impacts on the social and economic activities of many countries. CSM is designed to provide Meteorological Services and other national and international organizations with synthesized information on the state of the climate system and diagnostic insights into significant large-scale anomalies of regional and global consequence. A CSM Monthly Bulletin has been issued since July 1984. This report, the fourth biennial review of THE GLOBAL CLIMATE SYSTEM, is based on the current scientific understanding of the climate system and provides a basis for the monitoring of a global change. This monitoring supports efforts such as the newly formed Climate Change Detection Project of the WCDMP, by facilitating the identification of persistent anomalies on both global and regional scales, which is a necessary first step toward separating the 'signal' of climate change from the 'noise' of natural variability. Due to deficiencies in the global observing system, the diagnostic analysis of cause-effect relationships are preliminary for some regions and some climatic events or processes. Derived from text

N93-21452# National Oceanic and Atmospheric Administration, Boulder, CO. Wave Propagation Lab.

THEORY AND PERFORMANCE OF THE WPL CROSSWIND PROFILER MODEL 2

G. R. Ochs (Science and Technology Corp., Boulder, CO.), R. J. Lataitis, and J. J. Wilson Sep. 1992 41 p
(Contracts ASL-89-8003; IAR-6-87109)
(PB93-116606; NOAA-TM-ERL-WPL-227) Avail: CASI HC A03/MF A01; SOD HC

A system that measures the crosswind component at five locations along an optical path has been developed. The theory of operation is discussed, and wind data from the operation of the system on a 500-m path agrees well with that predicted by the theoretical analysis. GRA

N93-21478# National Hurricane Center, Coral Gables, FL.

DIAGNOSTIC REPORT OF THE NATIONAL HURRICANE CENTER. OCTOBER AND NOVEMBER 1991, VOLUME 4, NUMBER 3

Colin J. McAdie, ed., Lixion A. Avila, Harold P. Gerrish, Miles B. Lawrence, and Max Mayfield 1991 65 p
(PB93-126464) Avail: CASI HC A04/MF A01

Tropical cyclone activity in the Atlantic and Eastern Pacific Basins during Oct. and Nov. 1991 is described. Named tropical storms and hurricanes and an unnamed North Atlantic hurricane, 28 Oct. - 3 Nov. 1991, are described. Forecasting performance is assessed by discussing forecast tracking errors. GRA

N93-21492*# National Center for Atmospheric Research, Boulder, CO. Climate and Global Dynamics Div.

GLOBAL ANALYSES FROM ECMWF AND ATLAS OF 1000 TO 10 mb CIRCULATION STATISTICS

Kevin E. Trenberth Jun. 1992 195 p
(Grant NASA Order W-17661; NA86AA-N-RG0100)
(NASA-CR-192720; NAS 1.26:192720; PB92-218718; NCAR/TN-373+STR)
Avail: CASI HC A09/MF A03

The purpose of the project is to establish the climate record from global analyses of meteorological data. This record may be used in the diagnostic studies of the atmosphere, to compile climatologies which may then be used, among other things, to validate the Community Climate Model, and for examining anomalies such as occur in association with El Nino-Southern Oscillation events. To make optimal use of these data sets, it is necessary to know of any problems that might exist and the effects of any changes in the operational system that produced the analyses. Accordingly, we have gathered information from many sources in order to summarize what is known about the data sets. We have further carried out a number of tests of the internal consistency of the data. Thus, each data set has been documented and evaluated. The report describes the European Center for Medium Range Weather Forecasts (ECMWF) global analyses available to NCAR. GRA

N93-21502# National Oceanic and Atmospheric Administration, Rockville, MD. Meteorological Services and Supporting Research.

FEDERAL PLAN FOR METEOROLOGICAL SERVICES AND SUPPORTING RESEARCH, FY 1993

1992 140 p
(PB92-233188; FCM-P1-1992) Avail: CASI HC A07/MF A02

This Federal Plan, the 28th in the series that began in 1965, continues the tradition of summarizing the meteorological services and supporting research activities of all agencies of the Federal Government. As in the

past, the plan provides the Congress and the Executive Branch with a coordinated, overall plan for Government meteorological services and for those research and development programs that directly support and improve meteorological services. The plan covers the meteorological programs of all agencies for FY 1992 and FY 1993. GRA

N93-21503# National Oceanic and Atmospheric Administration, Miami, FL. Oceanographic and Meteorological Labs.
METEOROLOGICAL CONDITIONS OVER THE SOUTH ATLANTIC OCEAN DURING JULY AND AUGUST OF 1991
M. Robinette, S. R. Piotrowicz, R. S. Artz, and T. Pizer Aug. 1992 136 p
(PB92-235738; NOAA-TM-ERL-AOML-70) Avail: CASI HC A07/MF A02

In the austral winter of 1991, the NOAA Ship, Malcolm Baldrige, conducted a research cruise in the South Atlantic Ocean investigating ozone, carbon dioxide, and other related trace species which may be significant to the earth's radiation balance. To better understand the environmental conditions accompanying the acquired air samples, meteorological data were collected on board ship using twice daily rawinsondes. The meteorological data are presented using soundings and cross-sections along with synoptic maps and back-trajectories developed during post-cruise analyses. The synoptic maps illustrate the general meteorological conditions of the area in terms of pressure distribution at mean sea-level while the back-trajectories illustrate the flow of an air parcel due to the synoptic conditions over the 10 days prior to reaching the ship. GRA

N93-21535# Oregon State Univ., Corvallis.
DIGITAL TOPOGRAPHIC APPROACH TO MODELING: THE DISTRIBUTION OF PRECIPITATION TO MOUNTAINOUS TERRAIN
Christopher Daly and Ronald P. Neilson 1992 20 p Proceedings of the Annual Meeting of the American Institute of Hydrology, Portland, OR, 1992 Sponsored by Corvallis Environmental Research Lab., OR
(PB93-106649; EPA/600/A-92/195) Avail: CASI HC A03/MF A01

The demand for precipitation fields on a regular grid is growing dramatically as ecological and hydrological models become increasingly linked to spatial representations. However, a lack of data, as well as a conceptual framework for orographic precipitation, has hindered the development of accurate precipitation grids for complex terrain. The paper presents an analytical model that distributed point measurements of monthly average precipitation to a regular grid at regional to continental scales. GRA

N93-21787 WELS Research Corp., Boulder, CO.
INTELLIGENT AND LOCALIZED WEATHER PREDICTION
Elmar R. Reiter, David K. Doyle, and Luiz Teixeira Sep. 1992 144 p Sponsored in part by NAS-NRC and DOT
(Contract F49620-89-C-0036)
(PB93-117992; SHRP-ID/UFR-92-614) Copyright Avail: Issuing Activity

The report provides details for the design of a 24-hour weather prediction system for snow and ice control operations in road maintenance. The system accounts for detailed terrain effects on weather. Output is provided either in terms of weather maps at 6-hour intervals for meteorological users, or in terms of easy-to-read icons indicating rain, snow, temperature, and wind conditions, laid on top of terrain and road network sequences. Graphs of forecasts at specific locations can be manipulated by the user through simple mouse point-and-click actions, thus allowing forecast updates based upon local conditions. The system has been tested extensively during the winter of 1991-1992, and has performed excellently, providing details superior to those issued by the National Weather Service. GRA

N93-21799# Federal Aviation Administration, Cambridge, MA.
PROCEEDINGS OF THE AIRCRAFT WAKE VORTICES CONFERENCE, VOLUME 2 Final Report
J. N. Hallock, ed. Jun. 1992 579 p Conference held in Washington, DC, 29-31 Oct. 1991 Sponsored by FAA, Washington, DC, NOAA, Rockville, MD, NASA, and National Transportation Safety Board, Washington, DC Original contains color illustrations reproduced in black and white
(PB93-127728; DOT/VNTSC-FAA-92-7-Vol-2; DOT/FAA/SD-92/1-Vol-2)
Avail: CASI HC A25/MF A06

The volume contains the proceedings of the international conference of Aircraft Wake Vortices held at the Quality Hotel Capital Hill, Washington, DC, on 29-31 Oct. 1991. The contributed papers discuss technological advances in the knowledge of the phenomenon, its effect on aircraft and airport capacity, detection techniques, and vortex avoidance schemes. GRA

N93-21544# Haebaru Prefecture High School, Okinawa (Japan).
PRODUCTION OF TEACHING MATERIALS FROM GEOSTATIONARY METEOROLOGICAL SATELLITE HIMAWARI IMAGES [KISHOU EISEI 'HIMAWARI' GAZOU NO KYOUZAIKA]
Isao Touma *In* NASDA, Proceedings of the 14th Earth Observation Symposium 25 Jul. 1992 p 34-45 In JAPANESE (For primary document see N93-21539 07-43)
Avail: CASI HC A03/MF A01

N93-21545# Japan Weather Association, Tokyo. Meteorological Information Center.
CHANGING WEATHER INFORMATION: ROLES OF METEOROLOGICAL INFORMATION THROUGH METEOROLOGICAL SATELLITES [KAWARU TENKI JOUHOU: KISHOU EISEI JOUHOU NO YAKUWARI]
Seiichi Saitou *In* NASDA, Proceedings of the 14th Earth Observation Symposium 25 Jul. 1992 p 46-57 In JAPANESE (For primary document see N93-21539 07-43)
Avail: CASI HC A03/MF A01

N93-21587# Bulgarian Academy of Sciences, Sofia. Space Research Inst.
EARTH RADIATION AND CLOUD COVER ANALYSIS USING NOAA SATELLITE DATA
V. S. Djepa-Petrova, B. I. Madjarov, P. V. Petrov, B. Bancheva, and V. I. Petrov *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 99-103 (For primary document see N93-21569 07-42)
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N93-21588# Freie Univ., Berlin (Germany). Inst. fuer Meteorologie.
THE INFLUENCE OF HIGH CLOUDS ON CLIMATE
Franz H. Berger *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 105-109 (For primary document see N93-21569 07-42)
(Contracts BMFT-513-8320-KF-10110; BMFT-07-KFT-38/3)
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N93-21589# Hamburg Univ. (Germany). Meteorologisches Inst.
CLOUD-GENERATED RADIATIVE HEATING DETERMINED FROM SATELLITE MEASUREMENTS
U. Schmid, E. Raschke (GKSS-Forschungszentrum Geesthacht, Germany.), M. Rieland (Deutscher Bundestag, Bonn, Germany.), and R. Stuhlmann (GKSS-Forschungszentrum Geesthacht, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 111-113 (For primary document see N93-21569 07-42)
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N93-21590# Hamburg Univ. (Germany). Meteorologisches Inst.
ESTIMATING THE VERTICAL DIMENSION OF CONVECTIVE CLOUDINESS OVER THE POLAR OCEAN FROM AVHRR DATA
Andreas Manschke *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 115-116 (For primary document see N93-21569 07-42)
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N93-21591# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Inst. fuer Physik der Atmosphaere.
DETECTION OF POLAR STRATOSPHERIC CLOUDS FROM SATELLITE
R. Meerkoetter, R. Buell, and P. Wendling *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 117-121 (For primary document see N93-21569 07-42)
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N93-21599# Deutscher Wetterdienst, Offenbach am Main (Germany).
COMPARISON OF MONTHLY PRECIPITATION ANALYSES DERIVED FROM CONVENTIONAL MEASUREMENTS, SATELLITE ESTIMATES AND MODEL RESULTS
B. Rudolf, H. Hauschild, M. Reiss, and U. Schneider *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 157-162 (For primary document see N93-21569 07-42)
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N93-21600*# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
MICROWAVE RADIOMETRY FOR MONITORING THE DIVERSE CLOUDINESS REGIMES ON EARTH: A REVIEW
Kristina B. Katsaros *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 163-168 (For primary document see N93-21569 07-42)
(Grants NAGw-1688; NAG5-943)
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N93-21601# Laboratoire de Meteorologie Dynamique, Paris (France).
CLIMATOLOGICAL USE OF LONG TIME SERIES OF DATA FROM THE WATER VAPOUR CHANNEL OF METEOSAT
Michel Desbois, Laurence Picon, and Simeon Fongang (Dakar Univ., Senegal.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 169-172 (For primary document see N93-21569 07-42)
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N93-21605# United Nations Educational, Scientific and Cultural Organization, Paris (France). Water Sciences Div.
MONTHLY PRECIPITATION AND RUNOFF DATA FOR VALIDATION OF CLIMATE MODELS
A. Aureli, A. Becker (Freie Univ., Berlin, Germany.), S. Kaden (WASY Ltd., Berlin, Germany.), and S. I. Solomon *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 189-195 (For primary document see N93-21569 07-42)
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-21607# Italian Space Agency, Rome.
REQUIREMENTS AND PROJECTS FOR HIGH-RESOLUTION ATMOSPHERIC SOUNDING
Bizzarro Bizzarri *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 201-210 (For primary document see N93-21569 07-42)
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N93-21608# Swedish Meteorological and Hydrological Inst., Norkoeping.
USE OF AVHRR-DERIVED CLOUDINESS AND PRECIPITATION IN OPERATIONAL WEATHER FORECASTING AND IN MODEL STUDIES
Karl-Goeran Karlsson *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 211-216 (For primary document see N93-21569 07-42)
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N93-21610# European Centre for Medium-Range Weather Forecasts, Reading (England).
HOW REAL-TIME DATA ASSIMILATION BENEFITS WEATHER AND CLIMATE STUDIES THROUGH THE VALIDATION, QUALITY CONTROL AND SYNTHESIS OF REMOTELY SENSED DATA
A. Hollingsworth *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 223-224 (For primary document see N93-21569 07-42)
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N93-21611# Royal Netherlands Meteorological Inst., De Bilt.
ROUTINE VALIDATION OF TOVS RETRIEVALS: LESSONS LEARNED FROM A PILOT EXPERIMENT
G. J. Prangsma *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 225-228 (For primary document see N93-21569 07-42)
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N93-21613# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). HA Systemanalyse Raumfahrt.
RETRIEVAL OF CLOUD LIQUID WATER AND PRECIPITATION FROM POLARIZED MICROWAVE SIMULATIONS AND SSM/I MEASUREMENTS
Peter Bauer (Hamburg Univ., Germany.) and Peter Schluessel *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 235-240 (For primary document see N93-21569 07-42)
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N93-21614# Bulgarian Academy of Sciences, Sofia. Electronics Inst.
COMPARISON OF THE EFFICIENCIES OF LIDAR TECHNIQUES FOR ATMOSPHERIC-TEMPERATURE MEASUREMENT BASED ON ROTATIONAL RAMAN, AND RAYLEIGH SCATTERING
I. D. Ivanova, L. L. Gurdev, and V. M. Mitev *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 241-244 (For primary document see N93-21569 07-42)
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N93-21615# Bulgarian Academy of Sciences, Sofia. Solar-Terrestrial Influence Lab.
MODEL PROFILES OF ATMOSPHERIC TEMPERATURES, PRESSURES AND DENSITIES IN SOUTH-EASTERN EUROPE DURING MAXIMUM AND MIMIMUM SOLAR ACTIVITY
P. I. Vellinov, Khristo V. Spassov, and Liubka P. Milenkova *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 245-250 (For primary document see N93-21569 07-42)
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N93-21617# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany). Optoelectronics Inst.
REPRESENTATIVITY OF WIND MEASUREMENT FROM SPACE
C. Werner, J. Streicher, and G. Wildgruber (Sensorlab G.m.b.H., Munich, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 257-260 (For primary document see N93-21569 07-42)
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N93-21619# Bulgarian Academy of Sciences, Sofia. Geophysics Inst.
EMPIRICAL MODEL OF WINDS IN SOUTH-EASTERN EUROPE IN CONNECTION WITH SOLAR ACTIVITY
Khristo V. Spassov, P. I. Vellinov, and Liubka P. Milenkova *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 267-271 (For primary document see N93-21569 07-42)
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N93-21620# Ecole Nationale Superieure des Mines, Sophia-Antipolis (France). Centre d'Energetique.
ASSIMILATION OF SATELLITE BORNE WIND SCATTEROMETER OBSERVATIONS
F. vandenBerghe and F. Cauneau *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 273-278 (For primary document see N93-21569 07-42)
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N93-21621# Deutscher Wetterdienst, Offenbach am Main (Germany).
UTILIZATION OF REMOTE SENSING DATA AT THE DEUTSCHER WETTERDIENST
W. Benesch *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 279-282 (For primary document see N93-21569 07-42)
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N93-21622# Centre de Meteorologie Spatiale, Lannion (France).
OPERATIONAL CLOUD CLASSIFICATION WITH METEOSAT DATA
B. Bellec, A. Brisson, P. LeBorgne, and A. Marsouin *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 283-288 (For primary document see N93-21569 07-42)
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N93-21623# Technische Univ., Vienna (Austria). Inst. of Meteorology.
QUALITATIVE AND QUANTITATIVE DIAGNOSIS OF CLOUD IMAGES FOR USE IN WEATHER FORECAST
V. Zwatz-Meise and J. Stockinger *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 289-295 (For primary document see N93-21569 07-42)
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N93-21624# Hungarian Meteorological Society, Budapest. Satellite Research Lab.
BISPECTRAL CLOUD ANALYSIS FOR THE ATLANTIC-EUROPEAN REGION USING DIGITAL METEOSAT IMAGES
E. Fejes and J. Kerenyi *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 297-300 (For primary document see N93-21569 07-42)
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N93-21626# Saga Univ. (Japan). Dept. of Information Science.
A COMPARATIVE STUDY OF ESTIMATION OF PARTIAL CLOUD COVERAGE WITHIN A PIXEL: PROPOSED ADAPTIVE LEAST SQUARE METHOD WITH CONSTRAINTS
K. Arai, Y. Ueda, and Y. Terayama *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 305-310 Sponsored by National Space Development Agency, Japan (For primary document see N93-21569 07-42)
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N93-21627# Hamburg Univ. (Germany). Meteorologisches Inst.
MEASUREMENT AND INTERPRETATION OF THE SUNLIGHT BACKSCATTERED FROM CLOUDS WITHIN THE OXYGEN-A ABSORPTION BAND
M. Kollewe, W. Cordes (GKSS-Forschungszentrum Geesthacht, Germany.), and J. Fischer (Technische Univ., Berlin, Germany.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 311-315 (For primary document see N93-21569 07-42)
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N93-21628# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany).
CLEOPATRA: A STEP TOWARDS GEWEX ON THE REGIONAL SCALE
P. Meischner, T. Hauf, W. Jaeschke (Johann-Wolfgang-Goethe-Univ., Frankfurt am Main, Germany.), T. Kriebel, W. Mauser (Technische Univ., Munich, Germany.), J. Nithack, H. Pruppacher (Mainz Univ., Germany.), A. Schroth, and U. Schumann *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 317-322 (For primary document see N93-21569 07-42)
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48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N93-20160*# National Aeronautics and Space Administration. Wallops Flight Facility, Wallops Island, VA.
RADAR OCEAN WAVE SPECTROMETER (ROWS) PREPROCESSING PROGRAM (PREROWS2.EXE). USER'S MANUAL AND PROGRAM DESCRIPTION
Charles R. Vaughn Jan. 1993 90 p
(NASA-TM-104579; Rept-93B00031; NAS 1.15:104579) Avail: CASI HC A05/MF A01

This Technical Memorandum is a user's manual with additional program documentation for the computer program PREROWS2.EXE. PREROWS2 works with data collected by an ocean wave spectrometer that uses radar (ROWS) as an active remote sensor. The original ROWS data acquisition subsystem was replaced with a PC in 1990. PREROWS2.EXE is a compiled QuickBasic 4.5 program that unpacks the recorded data, displays various variables, and provides for copying blocks of data from the original 8mm tape to a PC file. Author

N93-20564# Naval Research Lab., Washington, DC.
THEORY AND NUMERICAL MODELING OF LOW-FREQUENCY ACOUSTIC SCATTERING FROM BUBBLE PLUMES NEAR THE SEA SURFACE
R. F. Gragg and D. Wurmser 18 Dec. 1992 69 p
(AD-A259199; NRL/FR/7140-92-9391) Avail: CASI HC A04/MF A01

From a theoretical foundation in boundary integral equations, we develop and implement a general method for computing the complex acoustic scattering amplitudes of bubble plumes near the sea surface. The implementation, named BIRPS (Boundary Integral Resonant Plume Scatter) incorporates surface-image and resonance effects, and allows user-specified plume shapes, interior sound speed functions, and depths. Simulations with model intermediate plumes reveal multiple sub-kHz resonant features. The resonance spectrum depends mainly on the plume's size, shape, and mean sound speed. The Q of a resonance depends on these parameters and on the sound speed gradient. Resonant scattering responses have a nonquadratic depth dependence and an elevation dependence whose complexity and frequency sensitivity increase with frequency. BIRPS may be joined with a continuous wave (CW) propagation model to provide scattering simulations or with a multifrequency driver to generate reverberation predictions. Our results provide a theoretical/modeling component for the investigation of surface reverberation and are relevant to problems of resonant scattering from complex bodies in general. GRA

N93-20741# Beleidscommissie Remote Sensing, Delft (Netherlands).
IN-SITU DETERMINATION OF OPTICAL PROPERTIES OF SEA WATER AND PARTICLE CHARACTERISTICS IN THE CORFU SEA (MEDITERRANEAN): REPORT ON THE FIRST JOINT CAMPAIGN OF THE MITO PROJECT
G. B. J. Dubelaar (Technische Univ., Delft, Netherlands.), J. H. M. Hakvoort (Technische Univ., Delft, Netherlands.), J. Krijgsman (Technische Univ., Delft, Netherlands.), C. S. vanderReijden (Technische Univ., Delft, Netherlands.), and M. Donze (Technische Univ., Delft, Netherlands.) May 1992 94 p
(BCRS Proj. 2.1/TO-07)
(BCRS-92-04; ISBN-90-5411-038-4; ETN-92-92849) Avail: CASI HC A05/MF A01

Optical properties of the sea water and suspended particles were measured onboard of the research vessel and above and in the water column at selected stations and depths. Spectral reflection of the water surface was measured along the track of the ship. Spectral light absorption of the water was measured with an experimental submersible absorption meter. Depth profiles of absorption, and up and downwelling radiance were recorded. In addition photosynthetically available radiation was measured in the water column. From collected water samples absorption and light attenuation were measured with a spectrophotometer. Spectral data was recorded with 2 nm wavelength resolution. Flow cytometric analysis of untreated samples was carried out on board. Corresponding samples were preserved for analysis in the laboratory with a flow cytometer for algae. Details of the study area and field program, of the materials and methods used, and of the results obtained, are given. ESA

N93-20891*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
BOTSWANA WATER AND SURFACE ENERGY BALANCE RESEARCH PROGRAM. PART 1: INTEGRATED APPROACH AND FIELD CAMPAIGN RESULTS
A. A. vandeGriend (Vrije Univ., Amsterdam, Netherlands.), M. Owe, H. F. Vugts (Vrije Univ., Amsterdam, Netherlands.), and G. K. Ramothwa (Meteorological Services of Botswana, Gaborone.) Feb. 1992 50 p Sponsored by Vrije Univ. and Food and Agriculture Organization of the United Nations
(BCRS Proj. AO-4.4)
(NASA-TM-108607; NAS 1.15:108607; BCRS-91-38A2-Pt-1; ISBN-90-5411-028-7; ETN-92-92842) Avail: CASI HC A03/MF A01

The Botswana water and surface energy balance research program was developed to study and evaluate the integrated use of multispectral satellite remote sensing for monitoring the hydrological status of the Earth's surface. Results of the first part of the program (Botswana 1) which ran from 1 Jan. 1988 - 31 Dec. 1990 are summarized. Botswana 1 consisted of two major, mutually related components: a surface energy balance modeling component, built around an extensive field campaign; and a passive microwave research component which consisted of a retrospective study of large scale moisture conditions and Nimbus scanning multichannel microwave radiometer microwave signatures. The integrated approach of both components in general are described and activities performed during the surface energy modeling component including the extensive field campaign are summarized. The results of the passive microwave component are summarized. The key of the field campaign was a multilevel approach, whereby measurements by various similar sensors were made at several altitudes and resolution. Data collection was performed at two adjacent sites of contrasting surface character. The following measurements were made: micrometeorological measurements, surface temperatures, soil temperatures, soil moisture, vegetation (leaf area index and biomass), satellite data, aircraft data, atmospheric soundings, stomatal resistance, and surface emissivity. ESA

N93-21031# Texas A&M Univ., College Station. Dept. of Oceanography.
SHIP-OF-OPPORTUNITY HYDROGRAPHIC TRANSECT OF WARM-CORE EDDY TRITON: 27-29 JANUARY 1992
D. C. Biggs, ed. May 1992 181 p
(Contract DI-C-14-35-0001-30501)
(PB92-218171; TR-92-01-T) Avail: CASI HC A09/MF A02

From 27-29 January 1992, three Texas A&M University (TAMU) technicians made a 16 expandable bathythermograpy (XBT) + 8 conductivity and temperature versus depth (CTD) transect of the central Gulf of Mexico, as R/V GYRE returned to Galveston from contract work off west Africa. They also ran GYRE's acoustic Doppler current profilers (ACDP) and thermosalinograph to collect data on near-surface currents, temperature, and salinity while underway. From ARGOS-tracked buoy trajectories and AVHRR imagery provided shortly before the cruise by colleagues in industry and at Stennis Space Center, the authors knew that a large warm-core eddy, Triton, which had separated in fall 1991 from the loop current, was passing across the central gulf, and that it was centered approximately 26 deg N and 92 deg W. Because they wanted to sample the eddy to continue/extend previous observations of rings in the central and western gulf, they vectored R/V GYRE so that its homeward bound course from Grand Cayman island to Galveston passed through the point. GRA

N93-21049# Texas A&M Univ., College Station. Dept. of Oceanography.
HYDROGRAPHIC DATA FROM TEXAS CONTINENTAL SHELF AND THE NORTHWEST CONTINENTAL SLOPE OF THE GULF OF MEXICO: R/V GYRE CRUISE 92G-03 (16-20 MARCH 1992)
P. Santschi and D. C. Biggs, ed. May 1992 94 p
(Contract DI-C-14-35-0001-30501; NSF OCE-90-12103; NSF OCE-91-00233; NSF OCE-90-00343)
(PB92-218155; TR-92-02-T) Avail: CASI HC A05/MF A01

Cruise 92G-03 departed Galveston at 9 p.m. on March 15 and returned to Galveston at 6:30 p.m. on March 20, 1992. The principal science programs were interdisciplinary, with goals to (1) carry out large-volume sampling of Th, Ra, and Pb isotopes using the Multiple InSitu Pumping System, MIPS, which allows battery-operated in situ pumping at up to six user-selectable depths (six times three serially linked cartridges extracting suspended particles and dissolved radioisotopes); and (2) verify MIPS with independent techniques using Fe hydroxide precipitation and MnO2 impregnated acrylic fiber extractions of 100-200 liter of seawater, sampled from surface waters with a shipboard pump. GRA

N93-21214# Woods Hole Oceanographic Inst., MA. Hydrographic Programme Office.
WORLD OCEAN CIRCULATION EXPERIMENT. WOCE RESULTS OF AN OXYGEN/SALINITY COMPARISON CRUISE ON THE R/VVERNADSKY Technical Report, 27 Jun. - 8 Jul. 1991
Terrance Joyce, Sheldon Bacon, Pavel Kalashnikov, Alexander Romanov, and Marvel Stalcup Jul. 1992 78 p Sponsored by NSF and Intergovernmental Oceanographic Commission, Paris, France
(Grants NSF OCE-89-07815; NSF OCE-92-06184)
(PB93-116523; WOCE-93/92; WHOP-92-3) Avail: CASI HC A05/MF A01

The report summarizes the work under the auspices of the WOCE Hydrographic Program (WHP), which took place on the R/V Ademik Vernadsky in June-July 1991. The goal of the exercise was an international comparison/training cruise to obtain comparisons of water sampling methods and analytical techniques employed by several groups for the oceanographic

measurement of salinity and oxygen in seawater. The training aspect was formalized in a pre-cruise practicum held on board the vessel by Dr. Fred Culkin and Mr. Paul Ridout of Ocean Scientific International, the manufacturer of IAPSO Standard Seawater. At-sea comparisons of Russian Reference Water, manufactured in Moscow, were made with IAPSO water. Further work involved comparisons of a Guildline and a pair of SOKOL salinometers using reference water and natural seawater collected on the cruise. GRA

N93-21244# Woods Hole Oceanographic Inst., MA.
OBSERVATIONS OF TURBULENCE, INTERNAL WAVES, AND BACKGROUND FLOWS: AN INQUIRY INTO THE RELATIONSHIPS BETWEEN SCALES OF MOTION Ph.D. Thesis
Kurt L. Polzin Sep. 1992 248 p
(Contracts N00014-87-K-0007; N00014-89-J-1073)
(AD-A259361; WHOI-92-39) Avail: CASI HC A11/MF A03

Oceanic profile data are used to examine the parameterization of turbulent dissipation due to internal waves. For observations exhibiting GM (Munk 1981) internal wave characteristics, the dissipation magnitude and its functional dependence upon wave energy level and buoyancy frequency was best described by the dynamical model of Henyey et al. (1986). For non-GM wave fields, dissipations were modeled most effectively by a frequency based correction to this model. The Richardson number scaling model of Kunze et al. (1990) produced consistent dissipation estimates. Model agreement here appears a consequence of statistical dependence between velocity shear and strain, hypothesized to be an effect of turbulent fluxes. These fluxes can effect low wavenumber spectral amplitudes only in the limit of strong stratification, low average wave-frequency and Coriolis frequency. An internally consistent picture of mixing in the ocean results: Energy is transported through the internal wave spectrum to small vertical scales where it is dissipated via shear instability processes. We find background diffusivities small and independent of depth (less than 10 to the -5 sq m/s); heightened wave energy in the abyss associated with topographic features or larger scale flows appears needed for internal waves to cause the 1-10 x 10 to the -4 sq m/s diffusivities generally inferred from deep ocean hydrographic data. GRA

N93-21260# Colorado Univ., Boulder.
NONLINEAR OCEAN WAVES Progress Report, 1 Jan. - 31 Dec. 1992
Harvey Segur 12 Jan. 1993 4 p
(Contract N00014-92-J-1274)
(AD-A259335; Rept-153-4647) Avail: CASI HC A01/MF A01

Two separate lines of research have been developed under this contract: numerically induced chaos; and waves in shallow water. In (1), careful numerical studies show how numerical simulations of nonlinear dynamical systems can exhibit chaos, even for a dynamical system that is known not to be chaotic. In (2), explicit analytical models are used to describe waves in shallow water, without the usual restrictions to infinitesimal wave amplitudes or to one-dimensional waves. GRA

N93-21389# National Oceanic and Atmospheric Administration, Miami, FL. Atlantic Oceanographic and Meteorological Labs.
SHIPBOARD ACOUSTIC DOPPLER CURRENT PROFILER DATA COLLECTED DURING THE SUBTROPICAL ATLANTIC CLIMATE STUDIES (STACS) PROJECT (1989-1990)
W. Douglas Wilson and J. Allison Routt Sep. 1992 147 p
(PB93-116598; NOAA-DR-ERL-AOML-71) Avail: CASI HC A07/MF A02

The Subtropical Atlantic Climate Studies (STACS) Program of NOAA is directed at determining the role of ocean circulation in global atmospheric climate, providing data for numerical model verification, and developing monitoring strategies for climatically important circulation features. The initial emphasis of STACS was on the subtropics, where earlier studies suggested that oceanic heat flux in the Atlantic is a maximum. Results of an intensive two-year study of the Florida Current at 27 N provided data on its role in Atlantic circulation and oceanic heat flux. The study also provided a system for monitoring the current on a long-term basis. GRA

N93-21476# National Oceanic and Atmospheric Administration, Washington, DC.
NATIONAL OCEANOGRAPHIC DATA CENTER INVENTORY OF PHYSICAL OCEANOGRAPHIC PROFILES: GLOBAL DISTRIBUTIONS BY YEAR FOR ALL COUNTRIES
Sidney Levitus and Robert D. Gelfeld Oct. 1992 249 p
(PB93-116531; KORD-18) Avail: CASI HC A11/MF A03

A critical requirement for climate and global change research is the availability of digital global oceanographic data covering long time periods. It has been estimated that perhaps two-thirds of all global historical oceanographic data exist only in manuscript form in archives around the world, and thus effectively are not available to researchers and other users. To address this problem, the U.S. National Oceanographic Data Center (NODC)/World Data Center A for Oceanography (WDC-A) has begun an 'Oceanographic Data Archaeology and Rescue project. Data archaeology is the term used to describe the process of seeking out, restoring, evaluating, correcting, and interpreting historical data sets. Summarizing the data held in the world's maintained archives in digital form is a first step to allow researchers and data managers to know what data are available, where the gaps in data coverage are, and what data they have or have knowledge of that are not in these archives. The data distribution plots have been prepared from the NODC and WDC-A archives through June 1992 as part of this initial step. These plots for Mechanical, Expendable, and Selected Level Bathythermograph Profiles, CTD/STD Profiles, and Oceanographic Station Profiles have been prepared by yearly period. The publication is a first in a series. GRA

N93-21536# University of Southern California, Los Angeles. Sea Grant Program.
PERSPECTIVES ON THE MARINE ENVIRONMENT. PROCEEDINGS FROM A SYMPOSIUM ON THE MARINE ENVIRONMENT OF SOUTHERN CALIFORNIA
Phyllis M. Grifman, ed. and Susan E. Yoder, ed. 1991 132 p Symposium held in Los Angeles, CA, 10 May 1991 Sponsored by National Sea Grant Coll. Program, Silver Spring, MD
(Contract NOAA-NA-90-AA-D-SG525)
(PB93-120053; USCSG-TR-01-92) Avail: CASI HC A07/MF A02

Contents: Contaminant Trends in the Southern California Bight; Four Decades of Stress and Recovery; Marina Del Rey as a Fish Habitat; Studies of the Fish Fauna Since 1977; Invasive Exotic Plants--Threats to Coastal Ecosystems; Harvest Refuges and their Potential for Enhancing Reef Fisheries in Southern California; Habitat Value of a Southern California Artificial Reef; Implications for the Design of Environmental Assessment Studies; Seabirds as Indicators of the Oceanic Environment; and What can Southern California Learn from the Exxon Valdez Oil Spill Experience. GRA

N93-21688# National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
VENTS 1990 CLEFT SEGMENT PLUME MONITORING EXPERIMENT: PHYSICAL AND CHEMICAL DATA, NOAA SHIP DISCOVERER, SEPTEMBER 8-29, 1990
Catherine Nitchman, Richard A. Feely, Edward T. Baker, Katherine A. Krogslund (Washington Univ., Seattle.), Richard A. Mortlock (Columbia Univ., Palisades, NY.), David J. Pashinski, Sharon L. Walker, and Geoffrey T. Lebon Aug. 1992 82 p Prepared in cooperation with Washington Univ., Seattle; and Lamont-Doherty Geological Observatory, Palisades, NY
(PB93-116622; NOAA-DR-ERL-PMEL-40; CONTRIB-1378) Avail: CASI HC A05/MF A01

The report summarizes salinity, temperature, nutrient, and total suspended matter data collected during the NOAA VENTS cruise in September, 1990. These data were collected from September 8 to 29, 1990 over the Juan de Fuca Ridge. GRA

N93-21792# Hawaii Univ., Manoa. Dept. of Oceanography.
EVALUATION OF THE COBALT CRUST CONTINUUM ON SEAMOUNTS IN THE EEZ OF HAWAII Final Report, 1 Oct. 1989 - 30 Sep. 1991
Alexander Malahoff 1991 15 p Sponsored by Bureau of Mines
(Grants DI-G1185128; DI-G1195128)
(PB93-120848; BUMINES-OFR-103-92) Avail: CASI HC A03/MF A01

Cross Seamount is located at 18 deg 42'N, 158 degrees 17'W at a water depth of 500 meters at the truncated summit, and 4,500 meters at the base. The seamount is part of a chain of Cretaceous-age seamounts located 200 nautical miles south of the Island of Oahu. The southwest Hawaiian seamounts are a group of Cretaceous seamounts with extensive cobalt-rich manganese crust covered talus pavements located along steep slopes of the seamounts ranging in depth from 400 meters to 2,000

meters. We have cross-correlated the mineralogy of crusts collected with the PISCES 5 from Cross Seamount, where up to 6 centimeter thick cobalt and platinum enriched crusts have formed on coalesced pavements on talus chutes. GRA

N93-21793# Georgia Univ., Athens. Center for Applied Isotope Studies.
ADVANCED DESIGN FOR A SEAFLOOR GAMMA MEASUREMENT DATA COLLECTION SYSTEM Final Report, 1 Jul. 1988 - 30 Sep. 1991
John E. Noakes 28 Aug. 1992 14 p Sponsored by Bureau of Mines, Washington, DC Original contains color illustrations reproduced in black and white
(Grants DI-G1185128-1301; DI-G1195128-1301)
(PB93-105013; BUMINES-OFR-98-92) Avail: CASI HC A03/MF A01

The Center for Applied Isotope Studies (CAIS) conducted a three-year program to upgrade and field test the Gamma Isotope Measurement System (GIMS), one of several CAIS systems capable of rapid, remote surveillance and collection of seafloor data. The GIMS is designed specifically for detecting the gamma radiation that is emitted by naturally occurring radioactive minerals on or near the seafloor, which can then be used for the interpretation of seafloor lithology. The GIMS consists of a towed sled containing a gamma radiation detector and a battery pack, connected by signal cable to a shipboard data acquisition system. The system processes the gamma spectrum to identify certain radioactive isotopes, simultaneously measuring four levels of radioactivity. Following the three-year system upgrade program, the operational parameters of the GIMS were substantially improved from the prototype gamma radiation detection systems first developed in the mid-1970s. Gamma radiation detection sensitivity has been increased fourfold with the inclusion of a larger thallium-activated sodium iodide (NaI(Tl)) crystal detector. The maximum operating depth of the system was doubled to a capability of 300 feet at a towing speed of 3 knots, allowing access to extensive areas of seafloor that were not previously available for rapid survey investigation. Enhanced data processing, storage, and mapping capabilities now provide user access to gamma spectrum analyses and two- and three-dimensional maps in near real time. In addition to these improvements, computer software now in development at CAIS will be applicable to the GIMS system to permit real time mapping within the next year. GRA

N93-21578# Joint Research Centre of the European Communities, Ispra (Italy). Remote Sensing Applications Inst.
MARINE PRODUCTIVITY ALONG THE NORTHWEST COAST OF AFRICA (MAURITANIA): ESTIMATION FROM SATELLITE DATA
N. Hoepffner, T. Baker, L. VanCamp, L. Nykjaer, P. Schlittenhardt, and C. N. Murray *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 49-54 (For primary document see N93-21569 07-42)
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N93-21580# Joint Research Centre of the European Communities, Ispra (Italy). Remote Sensing Applications Inst.
MODEL PREDICTIONS OF THE CROSS-SLOPE TRANSPORT OF SHELF ORGANIC CARBON IN THE NORTHWEST AFRICAN UPWELLING ZONE CALIBRATED BY SATELLITE DERIVED PIGMENT FIELDS
Wolfram Schrimpf, Walter Eifler, and Albert Gabric (Griffith Univ., Nathan, Australia.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 57-63 (For primary document see N93-21569 07-42)
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N93-21592# Marine Research Inst., Helsinki (Finland).
USE OF ERS-1 SAR DATA IN NUMERICAL SEA ICE MODELING
Matti Leppaeranta and Zhanhai Zhang (National Research Center for Marine Environment Forecasting, Beijing, China.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 123-128 (For primary document see N93-21569 07-42)
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N93-21593# Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Radio and Space Science.
REMOTE SENSING OF ARCTIC SEA ICE USING THE ERS-1 SAR
J. Askne and L. Ulander *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 129-133 Sponsored by Swedish Board for Space Activities (For primary document see N93-21569 07-42)
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N93-21594# Hamburg Univ. (Germany). Meteorologisches Inst.
DETECTING NEW-ICE IN THE ARCTIC FROM MULTISPECTRAL SATELLITE DATA
Thomas Martin and Daniel Taurat *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 135-140 (For primary document see N93-21569 07-42)
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N93-21595# Mullard Space Science Lab., Dorking (England).
SATELLITE MONITORING OF GIANT TABULAR ICEBERGS Abstract Only
S. Laxon, C. G. Rapley, and G. Davies *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 141 (For primary document see N93-21569 07-42)
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N93-21596# Mullard Space Science Lab., Dorking (England).
SATELLITE RADAR ALTIMETRY OVER SEA ICE Abstract Only
S. Laxon *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 143 (For primary document see N93-21569 07-42)
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N93-21597# Bremen Univ. (Germany). Inst. of Remote Sensing.
IMPROVED USE OF PASSIVE MICROWAVE DATA FOR SEA ICE DETECTION
G. C. Heygster, B. A. Burns, T. Markus, L. Meyer-Lerbs, R. Sethmann, and R. P. Tietze *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 145-150 (For primary document see N93-21569 07-42)
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N93-21598# Centre National de Recherches Meteorologiques, Toulouse (France).
A 2 X CO2 EXPERIMENT WITH PRESCRIBED CHANGES IN SEA SURFACE TEMPERATURE
J.-F. Mahfouf, J.-F. Royer, and D. Cariolle *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 151-155 Sponsored by Programme National d'Etude de la Dynamique du Climat (For primary document see N93-21569 07-42)
(Contract EPOCH-0003-C-MB)
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N93-21616# Hamburg Univ. (Germany). Inst. fuer Meereskunde.
VALIDATION OF ERS-1 SYNTHETIC APERTURE RADAR FOR IMAGING OCEAN WAVES: FIRST RESULTS
Claus Bruening, Werner Alpers, Andreas Wilde (GKSS-Forschungszentrum Geesthacht, Germany.), and Friedwart Ziemer *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 251-255 (For primary document see N93-21569 07-42)
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N93-21629# Centre de Meteorologie Spatiale, Lannion (France).
SST MONITORING OF THE EUROPEAN SEAS WITH AVHRR DATA
M. Derrien, O. Gaillard, P. LeBorgne, C. LeGoas, and A. Marsouin *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 323-327 (For primary document see N93-21569 07-42)
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N93-21630# Southampton Univ. (England). Dept. of Oceanography.
MAPPING OF SATELLITE-DERIVED SEA SURFACE TEMPERATURES AT HIGH RESOLUTION IN CLOUDY REGIONS
Ian S. Robinson and Paul Smith *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 329-334 (For primary document see N93-21569 07-42)
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N93-21633# Joint Research Centre of the European Communities, Ispra (Italy). Remote Sensing Applications Inst.
SEASONAL SST AND UPWELLING INDICES ALONG THE NORTHWEST AFRICAN COAST
Leo Nykjaer and Lieve VanCamp *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 347-351 (For primary document see N93-21569 07-42)
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N93-21634# Telespazio, S.p.A., Rome (Italy).
SURFACE CIRCULATION IN THE ADRIATIC SEA AS OBSERVED BY AVHRR
G. Borzelli, S. Marullo, R. Ligi, and P. E. LaViolette (Mississippi State Univ., Mississippi State.) *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmosphere and Ocean Forecasting 1992 p 353-359 (For primary document see N93-21569 07-42)
Copyright Avail: CASI HC A02/MF A04; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC

N93-21641# Nansen Remote Sensing Center, Bergen (Norway).
PRELIMINARY RESULTS OF ALTIMETER DATA ANALYSIS FOR STUDYING THE WATER EXCHANGE BETWEEN THE ATLANTIC OCEAN AND THE NORDIC SEAS
P. Samuel, J. A. Johannessen, and O. M. Johannessen *In* ESA, Environment Observation and Climate Modelling Through International Space Projects. Volume 1: Remote Sensing for Global Change, Climate Change and Atmospheric and Ocean Forecasting 1992 p 393-39 (For primary document see N93-21569 07-42)
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51 LIFE SCIENCES (GENERAL)

N93-20848# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
TWO STRIKES AGAINST PERFECT PHYLOGENY
Hans L. Bodlaender, Mike R. Fellows (Victoria Univ., British Columbia.), and Tandy J. Warnow (University of Southern California, Los Angeles.) Feb. 1992 19 p
(Contract EEC-3075; NSF CCR-88-13632; NSF DMS-90-05833)
(RUU-CS-92-08; ETN-93-92808) Avail: CASI HC A03/MF A01

A study on perfect phylogeny is presented. A major effort in molecular biology is the computation of phylogenies for species sets. A longstanding open problem in this area is called the perfect phylogeny problem. For almost two decades the complexity of this problem remained open, with progress limited to polynomial time algorithms for a few special cases and relaxations of the problem shown to be NP complete. From an applications point of view, the problem is of interest both in its general form, where the number of characters may vary, and in its fixed parameter form. The perfect phylogeny problem has been shown to be equivalent to the problem of triangulating colored graphs. It has also been shown recently that for a given fixed number of characters, the yes-instances have bounded treewidth, opening the possibility of applying methodologies for bounded tree width to the fixed parameter form of the problem. The Perfect Phylogeny problem is shown to be difficult in two different ways. The general problem is shown to be NP complete, and the various finite state approaches for bounded treewidth are shown not to be applicable to the fixed parameter forms of the problem. ESA

N93-20959# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).
BIOCHEMICALLY ACTIVE LAYERS FOR SELECTIVE MATERIAL DETECTION SENSORS [BIOCHEMISCH ACTIVE SCHICHTEN FUER SENSOREN ZUR SELEKTIVEN STOFFDETEKTION]
Reinhold Hilpert 1992 17 p In GERMAN Presented at the Seminar on Grunbauelemente zur Chemischen Sensorik, Munich, Germany, 19-20 May 1992y 1992
(MBB-Z-0440-92-PUB; ETN-93-92756) Avail: CASI HC A03/MF A01

The requirements for biological components of biosensors are reviewed. The examples of blood glucose and pesticides in drinking water are given. Properties of metabolizing components such as enzymes are examined. The posibility of using antibodies as biosensors is investigated. The methods for the immobilization of biological components on the transducer are studied: adsorption bonding at the transducer surface, embedding in matrices or behind semipermeable membranes, covalent coupling. The difficulties of obtaining numerical data on biochemical reactions to estimate response time or sensitivity area of sensor are pointed out. ESA

N93-21230# Federal Coordinating Council for Science, Engineering and Technology, Washington, DC.
PROLOGUE TO ACTION. LIFE SCIENCES EDUCATION AND SCIENCE LITERACY
Mar. 1992 71 p Conference held in Columbus, OH, Jun. 1991; sponsored by US Public Health Service
(PB93-107514) Avail: CASI HC A04/MF A01

In recommendations springing from the Prologue to Action -- Life Sciences Education and Science Literacy Conference in Ohio, attendees overwhelmingly agreed that Public Health Service (PHS) should become an aggressive advocate for excellence and equality in life sciences education. Conference participants called for PHS to mobilize its corps of intramural and extramural scientists in the service of life sciences education and literacy by creatively combining the knowledge of scientists with the practical teaching skills of classroom teachers. Scientists should help train science teachers and other educators and help structure learning experiences to ensure that all students have a chance to develop the ability to think and learn on their own. Scientists should help train student teachers at the university level, for instance, and help revise undergraduate science curriculums. They should become local or national speakers, be mentors to local teachers, loan equipment to science class projects in local schools, and get involved in undergraduate and precollege curriculum development. The following summary of reports from the seven subcommittees includes

overview and discussions of their perspectives, issues, and recommendations for PHS. GRA

N93-21074# Canadian Space Agency, Ottawa (Ontario).
SPACE LIFE SCIENCES OVERVIEW
Alan Mortimer *In its* Spacebound 1991 1991 p 16-17 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21085# Health and Welfare Canada, Ottawa (Ontario).
THE DEVELOPMENT OF AN AUTOMATED CELL CULTURE SYSTEM FOR USE IN SPACE LIFE SCIENCE RESEARCH
J. McLean, R. Bradley, D. Brown (Ottawa Univ., Ontario.), D. Gibbons (Ottawa Univ., Ontario.), F. Johnson (Ottawa Univ., Ontario.), A. Mortimer (Canadian Space Agency, Ottawa, Ontario.), M. Goddard, F. Mandy, G. Frappier, and F. Ryan *In* Canadian Space Agency, Spacebound 1991 1991 p 72-73 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21097# Dalhousie Univ., Halifax (Nova Scotia). Dept. of Biology.
HOW DO ZOOPLANKTON FEED? A CRITICAL MICROGRAVITY EXPERIMENT
Daniel L. Jackson, Scott M. Gallager, and Ronald K. ODor *In* Canadian Space Agency, Spacebound 1991 1991 p 137-140 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21098# British Columbia Univ., Vancouver. Dept. of Oceanography and Zoology.
GRAVITY AS A FACTOR IN THE ORIENTATION AND VERTICAL MIGRATION OF MARINE ZOOPLANKTON
A. G. Lewis and J. Powlik *In* Canadian Space Agency, Spacebound 1991 1991 p 141-145 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21099*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
STUDYING THE EFFECTS OF MICROGRAVITY ON LOWER VERTEBRATE DEVELOPMENT AND BEHAVIOR Progress Report
Richard J. Wassersug (Dalhousie Univ., Halifax, Nova Scotia.), Scott Pronych (Dalhousie Univ., Halifax, Nova Scotia.), and Kenneth A. Souza *In* Canadian Space Agency, Spacebound 1991 1991 p 146-150 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21931# State Univ. of Western Connecticut, Danbury.
THE CHALLENGE OF BIODETECTION FOR SCREENING PERSONS CARRYING EXPLOSIVES
Curt David Weinstein, Sidney Weinstein, and Ronald Drozdenko (NeuroCommunication Research Labs., Inc., Danbury, CT.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 759-769 (For primary document see N93-21856 07-03)
Avail: CASI HC A03/MF A10

N93-21933# Defence Research Agency, Seveuales (England).
EXPLOSIVES SEARCH DOGS
Stan Lovett *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 774-775 (For primary document see N93-21856 07-03)
Avail: CASI HC A01/MF A10

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N93-20303*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
RADIOLOGICAL ASSESSMENT FOR SPACE STATION FREEDOM
Gautam D. Badhwar, Alva C. Hardy, Donald E. Robbins, and William Atwell (Rockwell International Corp., Houston, TX.) Jan. 1993 14 p
(NASA-TM-104758; S-703; NAS 1.15:104758) Avail: CASI HC A03/MF A01

Circumstances have made it necessary to reassess the risks to Space Station Freedom crewmembers that arise from exposure to the space radiation environment. An option is being considered to place it in an orbit similar to that of the Russian Mir space station. This means it would be in a 51.6 deg inclination orbit instead of the previously planned 28.5 deg inclination orbit. A broad range of altitudes is still being considered, although the baseline is a 407 km orbit. In addition, recent data from the Japanese A-bomb survivors has made it necessary for NASA to have the exposure limits reviewed. Preliminary findings of the National Council on Radiation Protection and Measurements indicate that the limits must be significantly reduced. Finally, the Space Station will be a laboratory where effects of long-term zero gravity on human physiology will be studied in detail. It is possible that a few crewmembers will be assigned to as many as three 1-year missions. Thus, their accumulated exposure will exceed 1,000 days. Results of this radiation risk assessment for Space Station Freedom crewmembers finds that females less than 35 years old will be confined to mission assignments where the altitude is less than about 400 km. Slight restrictions may also need to be made for male crewmembers less than 35 years old. Author

N93-20318*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
EFFECT OF AEROBIC CAPACITY ON LOWER BODY NEGATIVE PRESSURE (LBNP) TOLERANCE IN FEMALES
Alan D. Moore, Jr. (Krug Life Sciences, Inc., Houston, TX.), Suzanne M. Fortney, and Steven F. Siconolfi Washington Mar. 1993 14 p
(NASA-TP-3298; S-695; NAS 1.60:3298) Avail: CASI HC A03/MF A01

This investigation determined whether a relationship exists in females between: (1) aerobic capacity and Lower Body Negative Pressure (LBNP); and (2) aerobic capacity and change in LBNP tolerance induced by bed rest. Nine females, age 27-47 (34.6 plus or minus 6.0 (Mean plus or minus SD)), completed a treadmill-graded exercise test to establish aerobic capacity. A presyncopal-limited LBNP test was performed prior to and after 13 days of bed rest at a 6 deg head-down tilt. LBNP tolerance was quantified as: (1) the absolute level of negative pressure (NP) tolerated for greater than or equal to 60 sec; and (2) Luft's Cumulative Stress Index (CSI). Aerobic capacity was 33.3 plus or minus 5.0 mL/kg/min and ranged from 25.7 to 38.7. Bed rest was associated with a decrease in NP tolerance (-9.04 1.6 kPa(-67.8 plus or minus 12.0 mmHg) versus -7.7 1.1 kPa(-57.8 plus or minus 8.33 mmHg); $p = 0.028$) and in CSI (99.4 27.4 kPa min(745.7 plus or minus 205.4 mmHg min) versus 77.0 16.9 kPa min (577.3 plus or minus mmHg min); $p = 0.008$). The correlation between aerobic capacity and absolute NP or CSI pre-bed rest did not differ significantly from zero ($r = -0.56$, $p = 0.11$ for NP; and $r = -0.52$, $p = 0.16$ for CSI). Also, no significant correlation was observed between aerobic and pre- to post-rest change for absolute NP tolerance ($r = -0.35$, $p = 0.35$) or CSI ($r = -0.32$, $p = 0.40$). Therefore, a significant relationship does not exist between aerobic capacity and orthostatic function or change in orthostatic function induced by bed rest. Author

N93-20384# Army Research Inst. of Environmental Medicine, Natick, MA.
NUTRITION AND HYDRATION STATUS OF AIRCREW MEMBERS CONSUMING THE FOOD PACKET, SURVIVAL, GENERAL PURPOSE, IMPROVED DURING A SIMULATED SURVIVAL SCENARIO Final Report, Jun. 1991 - Nov. 1992
Tanya E. Jones, Susan H. Mutter, Judy M. Aylward, James P. DeLany, and Robert L. Stephens Nov. 1992 126 p
(DA Proj. 3M2-63002-D-819)
(AD-A258744; USARIEM-T1-93) Avail: CASI HC A07/MF A02

Adequate nutrition and hydration can be crucial to the survival of downed aircrews. To determine the nutritional adequacy and palatability of an improved, all-purpose, all-environment survival packet (GP-I) compared to the old survival packet (GP), a field test was conducted using combat survival school students. During a five day survival exercise, 41 aircrew member's ate the GP-I and 57 ate the GP. Nutrition/hydration status were assessed from food/fluid intake records as well as changes in body weight. Water turnover was measured in a subset of subjects (n=30) using deuterium oxide. Pre- and posttest hemoglobin, hematocrit plasma osmolality, urine specific gravity (SG) and ketones were also measured. Acceptability of the two rations was evaluated. Subjects eating the GP-I consumed more Calories; GP-I 774+/-436 vs GP 642+/-408 kcal/d. Carbohydrate and protein consumption were similar but the GP-I group ate significantly more fat, 35+/-21 vs 24+/-18 g/d. Mean fluid intake was similar for both groups (GP-I 4.3+/-1.7, GP 4.4+/-1.9 L/d). Sodium intakes were 1.6 g/d. Weight decreased significantly for the GP-I and GP groups (2.9+/-1.4, 3.4+/-1.7 kg, respectively); changes were similar between groups. Water turnover data indicated subjects maintained adequate hydration as did hemoglobin, hematocrit, and plasma osmolality. Mean posttest urine SG was 1.024-/+0.007 and moderate amounts of ketones were detected. Both rations received favorable ratings, but the greater variety of the GP-I ration resulted in higher acceptability ratings for this ration. We conclude from these results that either ration is adequate, however, the variety and palatability of the GP-I is more desirable than He GP. GRA

N93-20400# Army Aeromedical Research Lab., Fort Rucker, AL.
EFFECTS OF MICROCLIMATE COOLING ON PHYSIOLOGY AND PERFORMANCE WHILE FLYING THE UH-60 HELICOPTER SIMULATOR IN NBC CONDITIONS IN A CONTROLLED HEAT ENVIRONMENT Final Report, May 1991 - May 1992
Robert J. Thornton, Lynn Caldwell, Frank Guardiani, and Jackie Pearson Aug. 1992 250 p
(AD-A258502; USAARL-92-32) Avail: CASI HC A11/MF A03

The effects of microclimate cooling on aviator performance and physiology in nuclear, biological, and chemical (NBC) individual protective equipment (IPE) were evaluated in the USAARL UH-60 research flight simulator. Sixteen male aviators flew the simulator in two temperature conditions, 95 F and 105 F, both at 50 percent relative humidity (RH). Two thermoelectric conditioning units were used, one providing cooled blown air, the other cooled water to the aviators. At each temperature, they flew for up to 6 hours in NBC IPE with no cooling, air cooling, and liquid cooling. There was an extra condition at 105 F when vent air with no cooling was blown through the air vest, making a total of seven test conditions. There were significant improvements in flight performance as a result of the cooling, more so at the higher temperature. Also, there were differences between the two cooling systems at 105 F, with the air system producing significantly lower flight error rates. Survival time was based on the length of time each subject stayed in the condition before reaching physiological withdrawal criteria (rectal temperature of 39 C or heart rate of 150 beats per minute for 15 minutes) or exercising their option to retire early. There were considerable increases in survival time with the use of microclimate cooling. The mean survival time at 95 F was increased to 385 minutes with the liquid system from 285 minutes without cooling. At 105 F to 333 minutes for the air system from 79 minutes with no cooling, the improvement was even more dramatic. There were significant differences between the two cooling systems at 105 F with the air system producing longer survival times. GRA

N93-20563# Duke Univ., Durham, NC.
RETINAL INFORMATION PROCESSING FOR MINIMUM LASER LESION DETECTION AND CUMULATIVE DAMAGE Final Report, 1 May 1989 - 30 Apr. 1992
Myron L. Wolbarsht 17 Sep. 1992 24 p
(Contract DAMD17-89-C-9027; DA Proj. 3M1-62787-A-878)
(AD-A259195) Avail: CASI HC A03/MF A01

Minimum ophthalmoscopically visual lesions are not perceived very well by the injured person either from clinical experience or other forms of testing, certainly not with the detail that retinal images of the same size are seen. Previous experiments have suggested a model for retinal organization suitable for small detail detection but which will not detect retinal small lesions very well. Smaller lesions of a sub-threshold nature can cause histological damage but are not visible ophthalmoscopically, nor can they be demonstrated to cause a loss of function. A series of animal experiments has been carried out to test the electrophysiological responses of retinal ganglion cells with sufficient resolution to detect threshold laser exposures with possible deficits in perceiving moving spot/edges and other optical discontinuities. The results are accurate with high resolution and the results should be correlated with supra-threshold exposures of a level to cause sub-retinal hemorrhages and/or vitreous hemorrhages. Both qualitative and quantitative comparisons are needed between the kind of damage caused by sub-threshold, barely threshold, and markedly supra-threshold lesions on this aspect of retinal organization. GRA

N93-20580# Naval Aerospace Medical Research Lab., Pensacola, FL.
SUBJECTIVE FATIGUE IN A-6, F-14, AND F/A-18 AIRCREWS DURING OPERATIONS DESERT SHIELD AND STORM Interim Report
C. A. DeJohn, S. A. Shappell, and D. F. Neri Oct. 1992 19 p
(Proj. MM3-3-P-30)
(AD-A259243; NAMRL-1377) Avail: CASI HC A03/MF A01

Fatigue during naval air combat can reduce performance, impair operational effectiveness, and compromise safety. This study examines the effect of combat missions on the subjective fatigue of naval aircrews deployed aboard USS AMERICA during Desert Shield and Desert Storm. Fatigue was determined using three questionnaires that were completed before and after each mission. Although fatigue significantly increased during combat missions, it usually returned to preflight levels by the next day without noticeably increasing as the operation progressed. We feel that judicious aircrew scheduling on the part of operational planners was one of the most important factors contributing to this result. To minimize fatigue during naval air combat operations, we recommend that, as resources permit, 'no-fly' days be regularly scheduled, only one or two missions should be scheduled per day, and adequate crew rest should be planned between missions. GRA

N93-20587# Naval Submarine Medical Research Lab., Groton, CT.
STATISTICALLY BASED DECOMPRESSION TABLES. 7: SELECTION AND TREATMENT OF PRIMARY AIR AND N2O2 DATA Final Report, Aug. 1986 - Feb. 1992
P. K. Weathersby, S. S. Survanshi, R. Y. Nishi, and E. D. Thalmann 18 Sep. 1992 120 p
(Proj. M00-99)
(AD-A259090; NSMRL-1182; NMRI-92-85) Avail: CASI HC A06/MF A02

Probabilistic models of decompression sickness (DCS) require high quality data of diving profiles and DCS occurrence to get reliable predictions of the probability of DCS, P(DCS). Over 400 experimental dives performed since 1977 in the U.S., U.K., and Canada were collected, verified, and formatted for use in probabilistic models. In most cases the dive profile precision is within 1 fsw in depth, 30 sec in time, and 0.1 ATA in PO2. DCS outcome and other medical records are of the highest quality expected for test dives done in military laboratories. The data sources, steps used in the review and formatting process, and summaries of the data collection are described. GRA

N93-20736*# Florida Inst. of Tech., Melbourne. Dept. of Biological Sciences.
RAPID SUSCEPTIBILITY TESTING OF MYCOBACTERIUM AVIUM COMPLEX AND MYCOBACTERIUM TUBERCULOSIS ISOLATED FROM AIDS PATIENTS Interim Report, 1 Oct. 1992 - 31 Jan. 1993
Arvind M. Dhople 31 Jan. 1993 14 p
(Grant NAG10-0106)
(NASA-CR-192382; NAS 1.26:192382) Avail: CASI HC A03/MF A01

In ominous projections issued by both U.S. Public Health Service and the World Health Organization, the epidemic of the Human Immunodeficiency Virus (HIV) infection will continue to rise more rapidly worldwide than predicted earlier. The Acquired Immunodeficiency Syndrome (AIDS) patients are susceptible to diseases called opportunistic infections of which tuberculosis and M. avium Complex (MAC) infection are most common. This has created an urgent need to uncover new drugs for the treatment of these infections. In the seventies, NASA scientists at Goddard Space Flight Center, Greenbelt, Maryland, had adopted a biochemical indicator, adenosine triphosphate (ATP), to detect presence of life in extraterrestrial space. Therefore, we proposed to develop ATP assay technique to determine sensitivity of antibacterial compounds against MAC and M. tuberculosis.

The work was initiated in June 1992. In the last report, we described our efforts in developing ATP assay method using MAC. Studies were continued further, and during the period of this report, we established the relationship between colony forming units and ATP levels of these organisms during the growth cycle. Also, we evaluated the effects of standard antimycobacterial drugs using ATP assay technique and compared the results with those obtained with conventional tube dilution proportional method. Derived from text

N93-20889* National Aeronautics and Space Administration, Washington, DC.

AEROSPACE MEDICINE AND BIOLOGY: A CUMULATIVE INDEX TO A CONTINUING BIBLIOGRAPHY (SUPPLEMENT 371)

Jan. 1993 276 p

(NASA-SP-7011(371); NAS 1.21:7011(371)) Avail: CASI HC A13

This publication is a cumulative index to the abstracts contained in Supplements 359 through 370 of Aerospace Medicine and Biology: A Continuing Bibliography. It includes seven indexes: subject, personal author, corporate source, foreign technology, contract number, report number, and accession number. Author

N93-20998*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

TOXIC SUBSTANCES REGISTRY SYSTEM: INDEX OF MATERIAL SAFETY DATA SHEETS

Jul. 1992 839 p

(NASA-TM-108582; NASA-GP-23-1; NAS 1.15:108582) Avail: CASI HC A99/MF A10

The Jul. 1992 Revision of the KSC Toxic Substances Registry System (TSRS) Index of Material Safety Data Sheets (MSDS's) is presented. The listed MSDS's reflect product inventories and associated MSDS's which were submitted to the Toxic Substance Registry Data Base maintained by the Base Operations Contractors of the Biomedical Operations and Research Office of KSC. The purpose of the index is to provide a means of accessing information on the hazards associated with the toxic and otherwise hazardous chemicals stored and used at KSC. Indices are provided for manufacturers, trademarks, and stock numbers. CASI

N93-21044* National Aeronautics and Space Administration, Washington, DC.

AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 372)

Feb. 1993 79 p

(NASA-SP-7011(372); NAS 1.21:7011(372)) Avail: CASI HC A05

This bibliography lists 208 reports, articles and other documents introduced into the NASA Scientific and Technical Information System during Jan. 1993. Subject coverage includes: aerospace medicine and physiology, life support systems and man/system technology, protective clothing, exobiology and extraterrestrial life, planetary biology, and flight crew behavior and performance. Author

N93-21046# Health Effects Research Lab., Research Triangle Park, NC. Neurotoxicology Div.

MEASUREMENT OF BEHAVIORAL THERMOREGULATION

Christopher J. Gordon and Roberto Refinetti (College of William and Mary, Williamsburg, VA.) 1992 34 p Submitted for publication

(PB92-217033; EPA/600/A-92/166) Avail: CASI HC A03/MF A01

The measurement of thermoregulatory behavior by the techniques of thermal gradient and operant conditioning allows the study of many parameters of the behavioral control of body temperature in particular species as well as the comparative study of thermo-regulatory capabilities of different species. In neuroscience research, these techniques provide a reliable dependent variable for the investigation of the action of specific neurotransmitters and the specificity of particular brain loci involved in the regulation of body temperature. Much of the current knowledge about the neural control of thermoregulatory behavior has been obtained by using thermal gradients and operant conditioning in conjunction with systemic and intracerebral injections of neurotransmitters, local thermal stimulation of brain regions, and selective destruction of particular brain sites by electrolytic lesions. GRA

N93-21047# Federal Aviation Administration, Washington, DC. Office of Aviation Medicine.

GUIDE FOR AVIATION MEDICAL EXAMINERS

1992 191 p Revised

(PB92-219690) Avail: CASI HC A09/MF A02

The Guide for Aviation Medical Examiners was prepared to assist designated Aviation Medical Examiners in the efficient and effective performance of their duties and responsibilities as representatives of the Federal Aviation Administration (FAA). All material contained in the Guide is keyed to the corresponding item number contained on FAA Form 8500-8, Application for Airman Medical Certificate or Airman Medical and Student Pilot Certificate. Medical standards established by law are those contained in the Federal Aviation Regulations (FAR), Part 67 (14 CFR 67), a copy of which is included in the Guide for convenience and easy reference. The Guide includes the Federal Air Surgeon's interpretation of the Federal Aviation Regulations, Part 67, Medical Standards and Certification. GRA

N93-21369*# National Aeronautics and Space Administration, Washington, DC.

ENVIRONMENTAL HEALTH DISCIPLINE SCIENCE PLAN

1991 28 p

(NASA-TM-108042; NAS 1.15:108042) Avail: CASI HC A03/MF A01

The purpose of this plan is to provide a conceptual strategy for NASA's Life Sciences Division research and development activities in environmental health. It covers the significant research areas critical to NASA's programmatic requirements for the Extended Duration Orbiter, Space Station Freedom, and exploration mission science activities. These science activities include ground-based and flight; basic, applied, and operational; animal and human subjects; and research and development. This document summarizes the history and current status of the program elements, outlines available knowledge, establishes goals and objectives, identifies scientific priorities, and defines critical questions in the three disciplines: (1) Barophysiology, (2) Toxicology, and (3) Microbiology. This document contains a general plan that will be used by both NASA Headquarters Program Officers and the field centers to review and plan basic, applied, and operational research and development activities, both intramural and extramural, in this area. The document is divided into sections addressing these three disciplines. Author

N93-21498# National Academy of Sciences - National Research Council, Washington, DC.

MONITORING HUMAN TISSUES FOR TOXIC SUBSTANCES Final Report

1991 216 p

(PB92-223239; ISBN-0-309-04437-5; LC-91-61252) Avail: CASI HC A10/MF A03

The National Human Monitoring Program (NHMP) was established in 1967 within the U.S. Public Health Service to study changes in pesticide residues in the U.S. population. The primary activities of the NHMP are the National Human Adipose Tissue Survey (NHATS) and special studies that support other programs requiring data relevant to chemical exposures. The NHMP, including NHATS, was transferred to the Environmental Protection Agency (EPA) in 1970. The NHATS is now out of date and only partially fulfills its objectives. Design and management problems have been compounded by insufficient financial support for the changing and expanding objectives, and the overall quality of the NHATS has deteriorated. In 1987 EPA announced its intention to eliminate the NHMP. Congress responded by instructing EPA to retain the program, pending a review of its usefulness. EPA asked the National Research Council (NRC) to review and evaluate the effectiveness and potential applications of the NHMP. The report evaluates the current activities of the NHMP; identifies important scientific, technical, and programmatic issues; and makes recommendations regarding the design of the program and use of its products. GRA

N93-21112# Canadian Space Agency, Ottawa (Ontario).

CEREBRAL AUTOREGULATION IN MICROGRAVITY

R. Aaslid, R. L. Bondar, M. S. Kassam (Ryerson Polytechnical Inst., Toronto, Ontario.), F. Stein (Ryerson Polytechnical Inst., Toronto, Ontario.), and P. Dunphy (Ryerson Polytechnical Inst., Toronto, Ontario.) *In its* Spacebound 1991 1991 p 224-227 (For primary document see N93-21070 07-12) Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21114# Waterloo Univ. (Ontario). Dept. of Kinesiology.
RESPIRATORY RESPONSE TO VARYING DEGREES OF TILT AND LOWER BODY NEGATIVE PRESSURE
A. Blaber, M. Frazer, K. Shoemaker, and M. Sharratt *In* Canadian Space Agency, Spacebound 1991 1991 p 229-234 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N93-20326# Medical Research Council, London (England).
THE CENTRAL EXECUTIVE COMPONENT OF WORKING MEMORY Annual Report, 1 Sep. 1991 - 31 Aug. 1992
A. Baddeley, J. Duncan, and H. Emslie 31 Oct. 1992 21 p
(Grant AF-AFOSR-0343-90)
(AD-A258724; AFOSR-92-0946TR) Avail: CASI HC A03/MF A01

Our approach to the central executive (CE) involves combined studies of dual task interference, frontal lobe function and general intelligence or Spearman's g. In this reporting period we have focused on dual task interference, in particular using variants of Baddeley's (1986) random generation task, thought to load the CE because of its continual requirement for novel, non- stereotyped responding. Results suggest three main conclusions. First, the CE is modality-independent, in contrast to the peripheral slave systems of working memory. Second, there is a link between CE requirements and frontal lobe functions, indicated by substantial interference between random generation and a conventional frontal task, word fluency. Third, there is some tendency for tasks with high g correlations also to show the greatest interference with random generation. Taken together, these results support the convergence of methods from experimental cognitive psychology, neuropsychology and differential psychology, to define a common CE system. GRA

N93-20908*# Georgia Inst. of Tech., Atlanta. School of Industrial and Systems Engineering.
ACQUISITION AND PRODUCTION OF SKILLED BEHAVIOR IN DYNAMIC DECISION-MAKING TASKS Semiannual Status Report M.S. Thesis - Georgia Inst. of Tech., Nov. 1992
Alex Kirlik and Merrick Frank Kossack 5 Mar. 1993 193 p
(Grant NAG2-656)
(NASA-CR-192361; NAS 1.26:192361) Avail: CASI HC A09/MF A03

Previous use of various task analysis processes for the purpose of display interface design or enhancement has run the risk of failing to improve user performance due to the analysis resulting in only a sequential listing of user tasks. Adopting an ecological approach to performing the task analysis, however, may result in the necessary modeling of an unpredictable and variable task domain required to improve user performance. Kirlik has proposed an Ecological Task Analysis framework which is designed for this purpose. It is the purpose of this research to measure this framework's effectiveness at enhancing display interfaces in order to improve user performance. Following the proposed framework, an ecological task analysis of experienced users of a complex and dynamic laboratory task, Star Cruiser, was performed. Based on this analysis, display enhancements were proposed and implemented. An experiment was then conducted to compare this new version of Star Cruiser to the original. By measuring user performance at different tasks, it was determined that during early sessions, use of the enhanced display contributed to better user performance compared to that achieved using the original display. Furthermore, the results indicate that the enhancements proposed as a result of the ecological task analysis affected user performance differently depending on whether they are enhancements which aid in the selection of a possible action or in the performance of an action. Generalizations of these findings to larger, more complex systems were avoided since the analysis was only performed on this one particular system. Author

N93-21402# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany). Hubschrauber und Flugzeuge.
INSTRUCTIONS AND ADVANCE TRAINING MEASURES FOR THE IMPROVEMENT OF HUMAN RELIABILITY [AUS- UND WEITERBILDUNGSMASSNAHMEN ZUR VERBESSERUNG MENSCHLICHER ZUVERLAESSIGKEIT]
Siegfried Streubel 22 May 1992 38 p In GERMAN Presented at DGLR/VDI-Tagung Menschliche Zuverlaessigkeit, Munich, Germany, May 1992
(MBB-FE-313-S-PUB-0500; ETN-93-93434) Avail: CASI HC A03/MF A01

Responsibility is defined. Its properties and characteristics are given. The acquisition of knowledge and the development of capacities for a professional working qualification are outlined. Learning psychological problems are considered. Rescue measures are presented. Examples are described. Disturbances, such as fatigue, vigilance problems, drugs, and illnesses are reported. ESA

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N93-20050# Dayton Univ., OH. Research Inst.
NIGHT VISION GOGGLE TRAINING: DEVELOPMENT AND PRODUCTION OF SIX VIDEO PROGRAMS Final Report, Jan. - Nov. 1992
DeForest Q. Joralmon Nov. 1992 13 p
(Contract F33615-90-C-0005)
(AD-A258529; AL-TR-1992-0136) Avail: CASI HC A03/MF A01

A paper submitted to the 14th Interservice/Industry Training Systems Conference held 25 Nov. 1992 in San Antonio, TX is presented. With the increased use of night vision goggles (NVG) within the US Air Force, Navy, and Marine aviation communities, there is an expanded need for NVG training. The role of NVG training videos within the prototype NVG training course, the content of the presentations, and techniques used in the production of the programs are described. It concludes that video presentations showing examples of NVG imagery can successfully be used to augment NVG training. GRA

N93-20065*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
A MEMBRANE-BASED SUBSYSTEM FOR WATER-VAPOR RECOVERY FROM PLANT-GROWTH CHAMBERS
R. J. Ray (Bend Research, Inc., OR.) Sep. 1992 70 p
(Contract NAS2-13345)
(NASA-CR-177602; A-92193; NAS 1.26:177602) Avail: CASI HC A04/MF A01

Bioregenerative systems--life-support systems to regenerate oxygen, food, and water--are the key to establishing man's permanent presence in space. NASA is investigating the use of plant-growth chambers (PGC's) for space missions and for bases on the moon and Mars. PGC's serve several important purposes, including the following: (1) oxygen and food production; (2) carbon-dioxide removal; and (3) water purification and reuse. The key to the successful development of PGC's is a system to recover and reuse the water vapor that is transpired by the leaves of the growing plants. In this program we propose to develop a simple, reliable, membrane-based system that allows the recovery, purification, and reuse of the transpired water vapor through control of temperature and humidity levels in the PGC. This system has characteristics that make it ideally suited to use in space: (1) minimal power requirements; (2) small volume and mass; (3) simplicity; (4) reliability; and (5) versatility. In Phase 1 we will do the following: (1) develop an accurate, predictive model of our temperature- and humidity-control system, based on parametric tests of membrane modules; and (2) use this model to design systems for selected PGC's. In Phase 2, we will seek to design, fabricate, test, and deliver a breadboard unit to NASA for testing on a PGC. Author (revised)

N93-20314*# Research Inst. for Computing and Information Systems, Houston, TX.
MISSION AND SAFETY CRITICAL (MASC): AN EVACS SIMULATION WITH NESTED TRANSACTIONS Interim Report
David Auty (Softech, Inc., Houston, TX.), Colin Atkinson (Houston Univ., Clear Lake, TX.), and Charlie Randall (GHG Corp., Houston, TX.) Sep. 1992 47 p
(Contract NCC9-16; RICIS Proj. SE-16)
(NASA-CR-192295; NAS 1.26:192295) Avail: CASI HC A03/MF A01

The Extra-Vehicular Activity Control System (EVACS) Simulation with Nested Transactions, a recent effort of the MISSION Kernel Team, is documented. The EVACS simulation is a simulation of some aspects of the Extra-Vehicular Activity Control System, in particular, just the selection of communication frequencies. The simulation is a tool to explore mission and safety critical (MASC) applications. For the purpose of this effort, its current definition is quite narrow serving only as a starting point for prototyping purposes. (Note that EVACS itself has been supplanted in a larger scenario of a lunar outpost with astronauts and a lunar rover). The frequency selection scenario was modified to embed its processing in nested transactions. Again as a first step, only two aspects of transaction support were implemented in this prototype: architecture and state recovery. Issues of concurrency and distribution are yet to be addressed. Author

N93-20319*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
PHYSIOLOGICAL RESPONSES TO WEARING THE SPACE SHUTTLE LAUNCH AND ENTRY SUIT AND THE PROTOTYPE ADVANCED CREW ESCAPE SUIT COMPARED TO THE UNSUITED CONDITION
Linda H. Barrows (Krug Life Sciences, Inc., Houston, TX.), John J. McBrine (Krug Life Sciences, Inc., Houston, TX.), Judith C. Hayes (Krug Life Sciences, Inc., Houston, TX.), Marcella D. Stricklin (Krug Life Sciences, Inc., Houston, TX.), and Michael C. Greenisen Washington Mar. 1993 13 p
(NASA-TP-3297; S-694; NAS 1.60:3297) Avail: CASI HC A03/MF A01

The launch and entry suit (LES) is a life support suit worn during Orbiter ascent and descent. The impact of suit weight and restricted mobility on egress from the Orbiter during an emergency is unknown. An alternate suit - the advanced crew escape suite (ACES) - is being evaluated. The physiological responses to ambulatory exercise of six subjects wearing the LES and ACES were measured and compared to those measurements taken while unsuited. Dependent variables included heart rate and metabolic response to treadmill walking at 5.6 km/h (3.5 mph), and also bilateral concentric muscle strength about the knee, shoulder, and elbow. No significant (p greater than 0.06) differences in heart rate or metabolic variables were measured in either suit while walking at 5.6 km/h. Significant (p less than 0.05) decreases in all metabolic variables were remarked when both suits were compared to the unsuited condition. There were no significant (p greater than 0.05) differences among the three suit conditions at 30 or 180 deg/s for muscles about the elbow and knee; however, about the shoulder, a significant ($p = 0.0215$) difference between the ACES and the unsuited condition was noted. Therefore, wearing a life support suit while performing Orbiter egress imposes a significant metabolic demand on crewmembers. Selective upper body strength movements may be compromised. Author

N93-21215# Research Triangle Inst., Research Triangle Park, NC.
SURVEY OF PROTOCOLS FOR CONDUCTING INDOOR AIR QUALITY INVESTIGATIONS IN LARGE BUILDINGS
Roy C. Fortmann Jun. 1992 25 p Presented at the ASHRAE IAQ 1992 Conference on Environment for People, San Francisco, CA, 18-21 Oct. 1992; sponsored by EPA
(Contract EPA-68-02-4544)
(PB93-119865; EPA/600/A-92/226) Avail: CASI HC A03/MF A01

Numerous investigations are conducted in large buildings each year to evaluate health and comfort complaints that building occupants perceive to be related to poor indoor air quality. Some guidelines have been developed for conducting indoor air quality investigations, but standardized building diagnostics protocols have not been developed. The purpose of the work was to compile information that might be used to develop standardized protocols. A computerized literature search and a mail-out survey were conducted. A number of reports describing indoor air quality investigation guidelines and protocols were identified. The recently-published EPA/NIOSH Building Air Quality document contained the most comprehensive guidance. A survey of other documents identified many common elements, particularly for the collection of information during the initial walk-through investigation phases. GRA

N93-21269# Army Natick Research and Development Command, MA.
EVALUATION OF TWO MICROCLIMATE COOLING AIR VESTS ON A HEATED MANNEQUIN Final Report, Jun. - Aug. 1992
Roger Masadi and Brad Laprise Dec. 1992 17 p
(AD-A259410; Natick/TR-93/009) Avail: CASI HC A03/MF A01

This study compared the newly developed Microclimate Cooling Air Vest (MCAV) to the Combat Vehicle Crewman (CVC) Air Vest on a heated mannequin using a sweating skin. At flow rates of 12 and 15 cubic feet per minute, both vests were found to remove an equivalent amount of heat. In addition, the effect of each vest's resistance to air flow (pressure drop) is noted. GRA

N93-21370*# National Aeronautics and Space Administration, Washington, DC.
SPACE HUMAN FACTORS DISCIPLINE SCIENCE PLAN
1991 18 p
(NASA-TM-108023; NAS 1.15:108023) Avail: CASI HC A03/MF A01

The purpose of this Discipline Science Plan is to provide a conceptual strategy for NASA's Life Sciencos Division research and development activities in the comprehensive areas of behavior, performance, and human factors. This document summarizes the current status of the program, outlines available knowledge, establishes goals and objectives, defines critical questions in the subdiscipline areas, and identifies technological priorities. It covers the significant research areas critical to NASA's programmatic requirements for the Extended Duration Orbiter, Space Station Freedom, and Exploration mission science activities. These science activities include ground-based and flight; basic, applied and operational; and animal and human research and development. This document contains a general plan that will be used by both NASA Headquarters program offices and the field centers to review and plan basic, applied, and operational research and development activities, both intramural and extramural, in this area. Author

N93-21537# National Highway Traffic Safety Administration, East Liberty, OH. Vehicle Research and Test Center.
UPPER INTERIOR HEAD PROTECTION. VOLUME 1. THE DEVELOPMENT OF A RESEARCH TEST PROCEDURE Final Report
Donald T. Willke Nov. 1991 83 p
(PB93-113769; DOT-HS-807-865; VRTC-89-0140-Vol-1) Avail: CASI HC A05/MF A01

About 4000 fatalities and 9300 serious injuries result each year from occupants' heads striking various upper interior structures. The magnitude of the problem has prompted both the Government and industry to address the issue of reducing head injuries due to contact with these structures. Over the last several years, the Research and Development arm of the National Highway Traffic Safety Administration has conducted extensive research on the subject. The report, which is divided into two volumes, contains the results and findings from much of the work. A research test procedure for use in evaluating the potential for head injury due to impacts with vehicle upper interior structures is presented in Volume 1. This includes a discussion of the selection of a free-motion headform, as well as the results and analysis of testing done in the development of the component test procedure. Presented in Volume 2 are the results of tests conducted to estimate the potential for head injury in the current U.S. passenger vehicle fleet. The results of tests to evaluate the effectiveness of padding as a countermeasure are also included. All these tests were conducted following the research test procedure described in Volume 1. GRA

N93-21753# Vector Research, Inc., Arlington, VA.
REQUIREMENTS FOR AN AUTOMATED HUMAN FACTORS, MANPOWER, PERSONNEL, AND TRAINING (HMPT) PLANNING TOOL Final Report, 1 Aug. 1991 - 31 Jan. 1992
Susan M. Evans and Nicole A. Ritchie May 1992 85 p
(Contract F33657-91-C-2211)
(AD-A258531; VRI-AFHEL-1-FR-92-1; ASD-TR-92-5010) Avail: CASI HC A05/MF A01

This Phase 1 Small Business Innovative Research (SBIR) project investigated the impact of system design decisions on human operator

performance during concept development. The research established the functional and information requirements for an effective automated design analysis and crew performance assessment methodology for use in Premilestone 1 planning. The information structure included process, task, dynamic crew performance, operator graphic and human factors parameters, and training requirements. Existing automated tools such as the IDEF sub 0 structured analysis methodology, the SAINT task network simulation model and various operator graphic and human factors models were evaluated, along with other proven methodologies such as IDEAL and the Air Force's Instructional Systems Development (ISD) process. Insights from designers and other potential users identified special functional, information, and hardware requirements which were included in the methodology. The requirements will direct the implementation of an automated Human Factors, Manpower, Personnel, and Training System in Phase 2. The resulting system will make a significant contribution to the complex problems of considering HMPT issues early in system planning. It has potential application by elements in DoD program offices and organizations, and would also be of use in the private sector by those who are involved with the early concept phases in the design of complex human-operated systems.... Manpower, Personnel and training, Human performance, Process modeling, IDEF, Simulation modeling, Concept exploration, System planning. GRA

N93-21795# National Highway Traffic Safety Administration, East Liberty, OH. Vehicle Research and Test Center.

UPPER INTERIOR HEAD PROTECTION. VOLUME 2: FLEET CHARACTERIZATION AND COUNTERMEASURE EVALUATION Final Report

Donald T. Willke Nov. 1991 50 p

(PB93-113777; DOT/HS-807-866; VRTC-89-0140-Vol-2) Avail: CASI HC A03/MF A01

About 4000 fatalities and 9300 serious injuries result each year from occupants' heads striking various upper interior structures. The magnitude of the problem has prompted both the Government and industry to address the issue of reducing head injuries due to contact with these structures. Over the last several years, the Research and Development arm of the National Highway Traffic Safety Administration has conducted extensive research on the subject. The report, which is divided into two volumes, contains the results and findings from much of the work. A research test procedure for use in evaluating the potential for head injury due to impacts with vehicle upper interior structures is presented in Volume 1. This includes a discussion of the selection of a free-motion headform, as well as the results and analysis of testing done in the development of the component test procedure. Presented in Volume 2 are the results of tests conducted to estimate the potential for head injury in the current U.S. passenger vehicle fleet. The results of tests to evaluate the effectiveness of padding as a countermeasure are also included. All these tests were conducted following the research test procedure described in Volume 1. GRA

N93-22002*# McDonnell-Douglas Space Systems Co., Huntsville, AL.

SPACE STATION ECLSS INTEGRATION ANALYSIS Final Report

Jan. 1993 14 p

(Contract NAS8-36407)

(NASA-CR-192470; NAS 1.26:192470; MDC-93W5044) Avail: CASI HC A03/MF A01

The Space Station Environmental Control and Life Support System (ECLSS) contract with NASA MSFC covered the time frame from 9 May 1985 to 31 Dec. 1992. The contract roughly covered the period of Space Station Freedom (SSF) development from early Phase B through Phase C/D Critical Design Review (CDR). During this time, McDonnell Douglas Aerospace-Huntsville (formerly McDonnell Douglas Space Systems Company) performed an analytical support role to MSFC for the development of analytical math models and engineering trade studies related to the design of the ECLSS for the SSF. Author (revised)

N93-20413# National Space Development Agency, Ibaraki (Japan). Launch Vehicle and Satellite System Lab.

STUDY ON ENVIRONMENT CONTROL AND LIFE SUPPORT TECHNOLOGY [KANKYOU SEIGYO/SEIMEI IJI GIJUTSU NO CHOUSA KENTOU]

Tsutomu Iwata and Yukata Takano *In its* Research and Development Activities of the Tsukuba Space Center Aug. 1992 p 9-12 In JAPANESE (For primary document see N93-20410 07-12)

Avail: CASI HC A01/MF A03

N93-21113# York Univ. (Ontario). Inst. for Space and Terrestrial Science.

AIMED ARM MOVEMENTS UNDER CHANGED GRAVITY Abstract Only

O. Bock, I. Howard, K. Money, and K. Arnold *In* Canadian Space Agency, Spacebound 1991 1991 p 228 (For primary document see N93-21070 07-12)

Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21161# Technical Research Centre of Finland, Espoo. Fire Technology Lab.

CORRELATION OF RESULTS OF RADIANT HEAT TEST AND CONVECTIVE HEAT TEST FOR THREE LAYERED PROTECTIVE CLOTHING

Brita-Lisa Irjala, Djebar Baroudi, and Tanja Risikko *In its* Textiles and Composites 1992 1992 p 297-302 (For primary document see N93-21129 07-24)

Copyright Avail: CASI HC A02/MF A03

N93-21436*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

OPERATOR-ASSISTED PLANNING AND EXECUTION OF PROXIMITY OPERATIONS SUBJECT TO OPERATIONAL CONSTRAINTS Abstract Only

Arthur J. Grunwald and Stephen R. Ellis *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 28 (For primary document see N93-21407 07-12)

Avail: CASI HC A01/MF A01

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

N93-21807*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

ADVANCING AUTOMATION AND ROBOTICS TECHNOLOGY FOR THE SPACE STATION FREEDOM AND FOR THE U.S. ECONOMY Progress Report No. 15, 27 Feb. - 15 Sep. 1992

Henry Lum, Jr. Dec. 1992 46 p

(RTOP 476-14-01)

(NASA-TM-103992; A-93019; NAS 1.15:103992) Avail: CASI HC A03/MF A01

In April 1985, as required by Public Law 98-371, the NASA Advanced Technology Advisory Committee (ATAC) reported to Congress the results of its studies on advanced automation and robotics technology for use on Space Station Freedom. This material was documented in the initial report (NASA Technical Memorandum 87566). A further requirement of the law was that ATAC follow NASA's progress in this area and report to Congress semiannually. This report is the fifteenth in a series of progress updates and covers the period between 27 Feb. - 17 Sep. 1992. The progress made by Levels 1, 2, and 3 of the Space Station Freedom in developing and applying advanced automation and robotics technology is described. Emphasis was placed upon the Space Station Freedom program responses to specific recommendations made in ATAC Progress Report 14. Assessments are presented for these and other areas as they apply to the advancement of automation and robotics technology for Space Station Freedom. Author

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N93-20001# Carnegie-Mellon Univ., Pittsburgh, PA. School of Computer Science.

HUMAN-COMPUTER INTERACTION IN THE SCHOOL OF COMPUTER SCIENCE

Bonnie E. John, Philip L. Miller, Brad A. Myers, Christine M. Neuwirth, and Steven A. Shafer Oct. 1992 26 p

(AD-A258634; CMU-CS-92-193) Avail: CASI HC A03/MF A01

The SCS faculty interested in Human-Computer Interaction (HCI) presents its position on what role HCI can play in Carnegie Mellon's School of Computer Science. We present a short description of the need for HCI research and recommend a task/human/computer approach to satisfying that need. After presenting illustrative research scenarios, we draw implications of adopting this approach for our research and educational programs. SCS is well positioned to implement this approach, given the interests and skills of our faculty and faculty in other organizations at CMU. We recommend that the Computer Science Department form a new area in HCI. GRA

N93-20116* National Aeronautics and Space Administration. Pasadena Office, CA.

NEURAL-NETWORK DEDICATED PROCESSOR FOR SOLVING COMPETITIVE ASSIGNMENT PROBLEMS Patent

Silvio P. Eberhardt, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 16 Mar. 1993 16 p Filed 12 Aug. 1991 Supersedes N92-17884 (30 - 8, p 1337)

(NASA-Case-NPO-17781-1-CU; US-Patent-5,195,170; US-Patent-Appl-SN-744042; US-Patent-Class-395-24; US-Patent-Class-395-11; US-Patent-Class-395-23; Int-Patent-Class-G06F-15/18) Avail: US Patent and Trademark Office

A neural-network processor for solving first-order competitive assignment problems consists of a matrix of N x M processing units, each of which corresponds to the pairing of a first number of elements of (R sub i) with a second number of elements (C sub j), wherein limits of the first number are programmed in row control superneurons, and limits of the second number are programmed in column superneurons as MIN and MAX values. The cost (weight) W sub ij of the pairings is programmed separately into each PU. For each row and column of PU's, a dedicated constraint superneuron insures that the number of active neurons within the associated row or column fall within a specified range. Annealing is provided by gradually increasing the PU gain for each row and column or increasing positive feedback to each PU, the latter being effective to increase hysteresis of each PU or by combining both of these techniques.

Official Gazette of the U.S. Patent and Trademark Office

N93-20375# Pittsburgh Univ., PA.

COINCIDENT PULSE TECHNIQUES FOR HYBRID ELECTRONIC OPTICAL COMPUTER SYSTEMS Final Report, Jul. 1989 - Jul. 1992

Donald M. Chiarulli, Rami G. Melhem, and Steven P. Levitan 31 Aug. 1992 124 p

(Grant AF-AFOSR-0469-89)

(AD-A258692; AFOSR-92-1025TR) Avail: CASI HC A06/MF A02

This research is an investigation of the application of coincident pulse techniques to multiprocessor interconnection networks. The research focuses on three main areas: an examination of the applicability of coincident pulse techniques and required hardware to multiprocessor applications, an investigation of the limits of scalability, and an exploration of various interconnection structures which can be created using these techniques. GRA

N93-20594# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

DESIGN OF A LABORATORY COMPUTER INTERFACE M.S. Thesis

Douglas L. Durand Jun. 1992 106 p

(AD-A259126; AFIT/GEO/ENG/92D-01) Avail: CASI HC A06/MF A02

An interface for the LSI-11 computer was designed and implemented so that the computer supports data acquisition, data reduction, and equipment control. The design includes both hardware and software and addresses both parallel and serial input/output (I/0). The serial interface's hardware is simply a Serial Line Unit card. This card plugs into the LSI-11 bus and provides the signals necessary to interface EIA RS-232 compatible devices. A software utility was developed to allow communication with the serial device and to allow exchange of data files. Routines were written to allow serial I/O through a FORTRAN program. The interface's parallel hardware includes the general purpose laboratory interface system (GPLIS) architecture. In addition, hardware modules were designed to convert certain device's signal levels to TTL levels. Software utilities were developed to acquire and store parallel data and routines were written to allow parallel I/O through a FORTRAN program. GRA

N93-21027* National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

CRAY MINI MANUAL. REVISION D

Geoffrey M. Tennille and Lona M. Howser Jan. 1993 75 p

(RTOP 505-90-53-02)

(NASA-TM-107599-Rev-D; CSCC-CR-1d-Rev; NAS 1.15:107599-Rev-D) Avail: CASI HC A04/MF A01

This document briefly describes the use of the CRAY supercomputers that are an integral part of the Supercomputing Network Subsystem of the Central Scientific Computing Complex at LaRC. Features of the CRAY supercomputers are covered, including: FORTRAN, C, PASCAL, architectures of the CRAY-2 and CRAY Y-MP, the CRAY UNICOS environment, batch job submittal, debugging, performance analysis, parallel processing, utilities unique to CRAY, and documentation. The document is intended for all CRAY users as a ready reference to frequently asked questions and to more detailed information contained in the vendor manuals. It is appropriate for both the novice and the experienced user. Author

N93-21069# Technische Univ., Berlin (Germany). Fachbereich Elektrotechnik.

KNOWLEDGE-BASED CONSULTING SYSTEM FOR DYNAMIC NETWORK SECURITY CONTROL Ph.D. Thesis [WISSENSBASIERTES BERATUNGSSYSTEM ZUR DYNAMISCHEN NETZSICHERHEITSFUEHRUNG]

Frank Heibel 1992 111 p In GERMAN Sponsored by Siemens A.G.

(ETN-93-93420) Avail: CASI HC A06/MF A02

A hybrid approach for a consulting system is presented which combines a knowledge based system with a real time simulation system. All the network specific knowledge is included in the simulation system, while the content of the knowledge based component is completely independent from network structure. The presented knowledge base approach may be flexibly applied. The connection of the simulation systems enables later embedding of the expert system in existing network control environments. The concept was tested by prototype development. Further development will lead to a support system which could provide valuable assistance to the dispatch center of electric power utilities. ESA

N93-21183 Politecnico di Milano (Italy). Dipt. di Elettronica.

A RELOCATABLE COMPILER FOR MATHEMATICAL EXPRESSIONS

Victor V. Levitin (Academy of Sciences, USSR, Moscow.) 1992 22 p

(Rept-92-035; ETN-93-93035) Copyright Avail: Politecnico di Milano, Piazza Leonardo da Vinci, 20133 Milan, Italy

Work aimed at eliminating the gap between poor facilites of present software and the clear understanding of software facilities that should be provided is presented. The first version of the compiler described was implemented in TraX, a program for study orbits of ODE (Ordinary Differential Equations) and difference equations. The compiler was modified to allow more natural specification of ODE and was incorporated into LOCBIF program. A fully separate version of the compiler was implemented and is described. It can be used in TURBO PASCAL environment on IBM personal computers. ESA

N93-21185 Politecnico di Milano (Italy). Dipt. di Elettronica e Informazione.

FORMAL SPECIFICATION AND TIMING ANALYSIS OF HIGH-INTEGRITY REAL-TIME SYSTEMS

Miguel Felder, Carlo Ghezzi, and Mauro Pezze 1992 26 p Presented at NATO Advanced Study Institute on Real Time Computing, Sint Maarten, West Indies, 5-18 Oct. 1992 Sponsored in part by Commission of the

European Communities and CNR
(Rept-92-041; ETN-93-93038) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

The need for formal specification and verification of specifications in the case of high integrity real time systems is addressed. A review of sample approaches is given and attention is turned to Petri nets augmented to support timing requirements. A very general formalism and an associated timing analysis procedure are given. A restriction of the general model and a specialized analysis procedure are given. Concepts are mainly illustrated via examples and informal descriptions. ESA

N93-21255# National Inst. of Standards and Technology, Gaithersburg, MD. Computer Security Div.
COMPUTER SECURITY BULLETIN BOARD SYSTEM: USER'S GUIDE
Mark Skandera and Marianne Swanson Sep. 1992 43 p Revised
(PB93-113553; NISTIR-4933) Avail: CASI HC A03/MF A01

The Computer Security Act of 1987 assigned to the National Institute of Standards and Technology (NIST) the responsibility for providing federal agencies with advice and assistance in the area of computer security. To accomplish a portion of this task the NIST Computer Security Division maintains an electronic bulletin board system (BBS) which focuses on computer security issues. The NIST Computer Security BBS makes available to federal agencies and the public a wide variety of computer security information and encourages the sharing of information which can help users and managers protect their data and systems. The document describes the BBS and provides detailed instructions on how to use the many features. GRA

N93-21453# Executive Resource Associates, Inc., Arlington, VA.
FUNDAMENTALS OF PC OPERATION AND MAINTENANCE
Raymond E. Reilly Jan. 1992 440 p Sponsored by Agency for International Development
(PB93-117471; AID-PN-ABK-269) Avail: CASI HC A19/MF A04

Written for the average IBM-compatible personal computer (PC) user and the beginning-level support person, the manual provides a generic framework for understanding the functions and components common to all PC's (XT, AT, and PS/2 models), and gives detailed instructions for diagnosing and resolving simple problems and effecting basic repairs. It includes chapters on: basic PC concepts and functions; primary PC components, PC disassembly and assembly; storing data on magnetic media; DOS files and directories; decimal, binary, and hex numbers; preventive maintenance; basic troubleshooting; system diagnostics; installing adapter boards, disk drives, and memory; power supplies and backups; and printers. It also includes a glossary and illustrations. GRA

N93-21730# Oak Ridge National Lab., TN.
LEVEL 3 BLAS FOR DISTRIBUTED MEMORY CONCURRENT COMPUTERS
Jaeyoung Choi, D. W. Walker, and J. J. Dongarra (Tennessee Univ., Knoxville.) 1992 14 p Presented at the CNRS-NSF Collaboration Workshop on Environments and Tools for Parallel Scientific Computing, St. Hilaire du Touvet, France, 7-8 Sep. 1992
(Contract DE-AC05-84OR-21400)
(DE93-003613; CONF-9209274-2) Avail: CASI HC A03/MF A01

This paper discusses issues in developing a version of the Level 3 BLAS for distributed memory concurrent computers. The Level 3 BLAS are particularly important when using machines with hierarchical memory as they maximize reuse of data in the upper levels of the memory hierarchy. In implementing the distributed Level 3 BLAS, a block scattered decomposition is employed. Details of the parallel implementation of DGEMM, for performing matrix-matrix multiplication, and DTRSM, for solving triangular systems, are given, and results are presented for runs on the Intel Touchstone Delta computer. DOE

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N93-19981*# Polytechnic Univ., Farmingdale, NY. Dept. of Computer Science.
COMPUTER AIDED RELIABILITY, AVAILABILITY, AND SAFETY MODELING FOR FAULT-TOLERANT COMPUTER SYSTEMS WITH COMMENTARY ON THE HARP PROGRAM Final Report
Martin L. Shooman 1 Apr. 1991 120 p
(Grant NAG1-1001)
(NASA-CR-192405; NAS 1.26:192405) Avail: CASI HC A06/MF A02

Many of the most challenging reliability problems of our present decade involve complex distributed systems such as interconnected telephone switching computers, air traffic control centers, aircraft and space vehicles, and local area and wide area computer networks. In addition to the challenge of complexity, modern fault-tolerant computer systems require very high levels of reliability, e.g., avionic computers with MTTF goals of one billion hours. Most analysts find that it is too difficult to model such complex systems without computer aided design programs. In response to this need, NASA has developed a suite of computer aided reliability modeling programs beginning with CARE 3 and including a group of new programs such as: HARP, HARP-PC, Reliability Analysts Workbench (Combination of model solvers SURE, STEM, PAWS, and common front-end model ASSIST), and the Fault Tree Compiler. The HARP program is studied and how well the user can model systems using this program is investigated. One of the important objectives will be to study how user friendly this program is, e.g., how easy it is to model the system, provide the input information, and interpret the results. The experiences of the author and his graduate students who used HARP in two graduate courses are described. Some brief comparisons were made with the ARIES program which the students also used. Theoretical studies of the modeling techniques used in HARP are also included. Of course no answer can be any more accurate than the fidelity of the model, thus an Appendix is included which discusses modeling accuracy. A broad viewpoint is taken and all problems which occurred in the use of HARP are discussed. Such problems include: computer system problems, installation manual problems, user manual problems, program inconsistencies, program limitations, confusing notation, long run times, accuracy problems, etc. Author (revised)

N93-20006*# Illinois Univ., Urbana. Coordinated Science Lab.
THE PERFORMANCE OF CACHE-BASED ERROR RECOVERY IN MULTIPROCESSORS
Bob Janssens and W. F. Fuchs 25 Aug. 1992 24 p
(Contract NAG1-613; N00014-91-J-1283)
(NASA-CR-192142; NAS 1.26:192142; AD-A259426) Avail: CASI HC A03/MF A01

Several variations of cache-based checkpointing for rollback error recovery in shared-memory multiprocessors have been recently developed. By modifying the cache replacement policy, these techniques use the inherent redundancy in the memory hierarchy to periodically checkpoint the computation state. Three schemes, different in the manner in which they avoid rollback propagation, are evaluated. By simulation with address traces from parallel applications running on an Encore Multimax shared-memory multiprocessor, the performance effect of integrating the recovery schemes in the cache coherence protocol are evaluated. The results indicate that the cache-based schemes can provide checkpointing capability with low performance overhead but uncontrollable high variability in the checkpoint interval. GRA

N93-20033# Carnegie-Mellon Univ., Pittsburgh, PA. School of Computer Science.
EXPLICIT POLYMORPHISM AND CPS CONVERSION
Robert Harper and Mark Lillibridge Oct. 1992 25 p
(Contract F19628-91-C-0168; ARPA Order 8313)
(AD-A258635; CMU-CS-92-210) Avail: CASI HC A03/MF A01

The typing properties of continuation passing style (CPS) conversion for an extension of F(sub omega), with control operators is studied. Two

classes of evaluation strategies are considered, each with call-by-name and call-by-value variants. Under the 'standard' strategies, constructor abstractions are values, and constructor applications can lead to non-trivial control effects. In contrast, the 'ML-like' strategies evaluate beneath constructor abstractions, reflecting the usual interpretation of programs in languages based on implicit polymorphism. Three continuation passing style sub-languages are considered, one on which the standard strategies coincide, one on which the ML-like strategies coincide, and one on which all the strategies coincide. Compositional, type-preserving CPS transformation algorithms are given for the standard strategies, resulting in terms on which all evaluation strategies coincide. This has as a corollary the soundness and termination of well-typed programs under the standard evaluation strategies. A similar result is obtained for the ML-like call-by-name strategy. In contrast, such results are obtained for the call-by value ML-like strategy only for a restricted sub-language in which constructor abstractions are limited to values. GRA

N93-20058# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.

INTERACTIVE GRAPHICS SYSTEM FOR THE STUDY OF VARIANCE/COVARIANCE STRUCTURES OF BIVARIATE AND MULTIVARIATE NORMAL POPULATIONS M.S. Thesis

Ronald G. Garlicki Sep. 1992 214 p

(AD-A259449; AFIT/GSM/ENC/92S-9) Avail: CASI HC A10/MF A03

This research created a graphics oriented computer program which was used as part of a Visualization, Verbalization, Algorithmization, and Mathematization (VVAM) learning protocol. The curriculum for this research was the study of variance/covariance structures of bivariate and multivariate normal populations. The program displays the geometric images corresponding to the various possible covariance structures. These images facilitate and encourage experiment-based self discovery learning. The program encourages the student to take an active role in their own education. The program created is self contained, calculating all the statistical values it requires to create the various geometric images. The students have complete control in choosing what scenario they wish to study. The program was tested using four specific scenarios which represented a cross section of all possible scenarios. Within each of these scenarios were several options which were designed to encapsulate different aspects of the curriculum. The results of the research showed that the program, under the aegis of the VVAM, does facilitate the visualization and verbalization of the complex mathematical concepts associated with covariance structures. The learning environment was found to promote the creation of new knowledge on three distinct levels. GRA

N93-20059# Ecole Centrale de Lyon (France).

USER INTERFACE OF COMPLEX INTERACTIVE COMPUTER SYSTEMS Ph.D. Thesis [INTERFACE UTILISATEUR DES SYSTEMES INTERACTIFS COMPLEXES]

Salah Sadou 1992 199 p In FRENCH

(ECL-92-05; ETN-93-93051) Avail: CASI HC A09/MF A03

An approach to build user interfaces for complex interactive applications is proposed. The aim of the work is to develop an integrated system which takes into account the interface lifetime (design, management, evolution). The history of user interfaces and several system architectures are summarized. The concept allowing dissociation of the application semantics from the interface is applied. An approach to the generation of interfaces often found in computer aided design applications, which is able to evolve with the application requirements, is discussed. The importance of an interfacial intelligent support to model the application semantics to take into account the user level is demonstrated. An object base interface generator is developed and a suitable architecture for optimal interactive application is developed. ESA

N93-20128# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

A UNIFIED MODEL OF PROGRAM BEHAVIOR M.S. Thesis

Douglas T. Michel Dec. 1992 169 p

(AD-A259142; AFIT/GCS/ENG/92D-09) Avail: CASI HC A08/MF A02

This thesis is an attempt to account for and unify the three types of locality: temporal, spatial, and structural. A diverse sample of traces are used in measuring program behavior with respect to these localities and a model is presented which represents the memory references a program generates as it goes through execution. The model is validated by estimating the entropy of a synthetically generated trace and comparing it with actual traces. The results indicate that there is more predictability contained in the original trace than what the model was able to capture. Different variations of the model were tried and the results varied depending on the trace type being modeled. Various other measurements concerning temporal, spatial, and structural locality are used in building the model and provide interesting and useful insight into the memory referencing patterns of programs. GRA

N93-20220# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.

TOMITA'S ALGORITHM: EXTENSIONS AND APPLICATIONS

Rob Heemels, ed., Anton Nijholt, ed., and Klaas Sikkel, ed. Sep. 1991 103 p Proceedings of the First Twente Workshop on Language Technology, Enschede, Netherlands, 22 Mar. 1991

(Memo-INF-91-68; ETN-93-92819) Avail: CASI HC A06/MF A02

This volume contains the papers presented at a workshop in language technology. Tomita's algorithm is the generalized LR parsing algorithm introduced by Masaru Tomita. Since then, others have investigated the method both theoretically and empirically. Some of their results can be found in the proceedings of the 1st and 2nd International Workshop on Parsing Technologies. Papers concerned with generalized LR parsing and closely related methods are included. This volume contains: LR parsing from Knuth to Tomita, recursive ascent parsing, parsing algorithm for nondeterministic context sensitive languages, unrestricted online parsing and transduction with graph stacks, substring parsing for arbitrary context free grammars, detection and correction of morphosyntactic errors in shift-reduce parsing, Tomita's algorithm in practical applications, empirical comparison of generalized LR tables, and bottom-up parallelization of Tomita's algorithm. For individual titles, see N93-20221 through N93-20229.

N93-20221# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.

(GENERALIZED) LR PARSING: FROM KNUTH TO TOMITA

Anton Nijholt *In its* Tomita's Algorithm: Extensions and Applications Sep. 1991 p 1-8 (For primary document see N93-20220 07-61)

Avail: CASI HC A02/MF A02

The research in LR parsing and its applications are reviewed. The history of LR grammars and languages, LR parsing and parser optimization, generalizations of the LR grammar definition and parsing method, automatic parser construction, error handling, and LR parsing for natural language are addressed. The following papers on (generalized) LR parsing are summarized: recursive ascent parsing, a parsing algorithm for nondeterministic context sensitive languages, unrestricted online parsing and transduction with graph structured stacks, substring parsing for arbitrary context free grammars, detection and correction of morphosyntactic errors in shift reduced parsing, Tomita's algorithm in practical applications, an empirical comparison of generalized LR tables, and bottom up parallelization of Tomita's algorithm. ESA

N93-20222# Philips Gloeilampenfabrieken N.V., Eindhoven (Netherlands).

RECURSIVE ASCENT PARSING

Rene Leermakers *In* Univ. Twente, Tomita's Algorithm: Extensions and Applications Sep. 1991 p 9-19 (For primary document see N93-20220 07-61)

Avail: CASI HC A03/MF A02

The correctness of LR parsing is discussed. LR parsing is defined in a purely functional way, without constructing a push down automaton for each grammar. In this functional formulation, LR parsing turns out to be analogous to recursive descent parsing. The resulting parsers have a correctness proof that is extremely simple compared to the conventional ones. The recursive descent recognizer is presented. The recursive ascent recognizer as well as its proof are shown. The time and space complexities of the recognizer are analyzed, and the algorithm for constructing a cubic representation for parse forests is given. The extendability of the theory is demonstrated. A formalism for Marcus parsers is proposed and a natural family of look-ahead parsers is established. ESA

N93-20223# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.

A PARSING ALGORITHM FOR NON-DETERMINISTIC CONTEXT-SENSITIVE LANGUAGES

Henk Harkema and Masaru Tomita (Carnegie-Mellon Univ., Pittsburgh, PA.) *In its* Tomita's Algorithm: Extensions and Applications Sep. 1991 p 21-31 (For primary document see N93-20220 07-61)

Avail: CASI HC A03/MF A02

A shift reduce algorithm for the recognition of sentences of nondeterministic languages defined by context sensitive grammars is introduced. The algorithm is a composite of Tomita's efficient parsing method for nondeterministic languages and a procedure for processing deterministic context sensitive languages. The algorithm employs two stacks, one of which is used for representing the context of the several active processes. The other stack is the normal parsing stack. The two stacks are linked by means of a set of pointers. When manipulating context-sensitive languages in an LR manner, there is no need for a separate goto table anymore. In case of a reduce action, all the symbols of the left hand side of the rule under consideration are pushed back into the input buffer. The state which appears on top of the stack when having popped off the symbols of the right hand side, and the first symbol in the input buffer determine the next action. ESA

N93-20224# Amsterdam Univ. (Netherlands). Vakgroep Alfa-Informatica.

UNRESTRICTED ON-LINE PARSING AND TRANSDUCTION WITH GRAPH STRUCTURED STACKS

Gert J. vanderSteen *In* Univ. Twente, Tomita's Algorithm: Extensions and Applications Sep. 1991 p 33-60 (For primary document see N93-20220 07-61)

Avail: CASI HC A03/MF A02

A program generator for linguistic purposes is described with the following properties: (1) the formalism unifies weak equivalent formalisms for Chomsky type-0 grammars, cascaded transduction grammars, regular expressions, pattern matching, augmented transition networks, and attribute grammars; (2) in the compiler, extensions for the LR table generation technique are implemented; (3) the generated code runs on a formal machine which makes use of two dag structured stacks and which maintains a parse forest for the efficient storage of parses of ambiguous grammars, like in the algorithm of Tomita; (4) parsing is done online and transduction is done with finite delay; and (5) new bounds are obtained for the runtime of some pattern matching problems. The system was used in projects concerning the recognition patterns in tagged corpora of texts and music, for the parsing of a number of natural languages, for the transformation of graphemes into phonemes by a cascaded transduction grammar, for the recognition of compound words, for the classification of words in a number of languages, and for interactive detection of the structure of a document and its subsequent conversion into another format. ESA

N93-20225# Center for Mathematics and Computer Science, Amsterdam (Netherlands).

SUBSTRING PARSING FOR ARBITRARY CONTEXT-FREE GRAMMARS

Jan Rekers and Wilco Koorn (Amsterdam Univ., Netherlands.) *In* Univ. Twente, Tomita's Algorithm: Extensions and Applications Sep. 1991 p 61-68 Sponsored in part by Netherlands Organization for Applied Scientific Research TNO (For primary document see N93-20220 07-61) (ESPRIT Proj. 2177)

Avail: CASI HC A02/MF A02

A substring recognition algorithm is described. A substring recognizer for a language L determines whether a string s is a substring of a sentence in L. The algorithm for substring recognition presented accepts general context free grammars and uses the same parse tables as the general context free parsing algorithm from which it was derived. By extending the substring 'recognizer' with the ability to generate trees for the possible contextual completions of the substring, a substring 'parser', which can be used in a syntax directed editor to complete fragments of sentences, is obtained. The adaptation of the Tomita algorithm to substring parsing results in a powerful algorithm. The main advantage is that substring parsing can be applied in a very general manner. Substring parsing is slower than ordinary parsing. The use of the substring parser in incremental parsing has to be investigated. ESA

N93-20226# Nijmegen Univ. (Netherlands). Inst. for Cognitive Research and Information Technology.

DETECTION AND CORRECTION OF MORPHO-SYNTACTIC ERRORS IN SHIFT-REDUCE PARSING

Theo Vosse *In* Univ. Twente, Tomita's Algorithm: Extensions and Applications Sep. 1991 p 69-77 (For primary document see N93-20220 07-61)

Avail: CASI HC A02/MF A02

A systematic approach to detecting and correcting morphosyntactic errors using a shift reduce parser for augmented context free grammars is described. In particular, adaptations to the Tomita parsing algorithm are studied. The types of errors to detect and possibly correct, and the need for a parser, are discussed. Augmented context free grammars and shift reduce parsers for these grammars are discussed, with special attention paid to applying them in error detection. The adaptations to the Tomita algorithm needed to efficiently deal with erroneous input are discussed. The use of the parse results to correct the errors is considered. Some of the results of this approach are evaluated using this scheme in a Dutch grammar checking system. ESA

N93-20227# Oce Nederland B.V., Venlo. Dept. of Language and Speech Technology.

TOMITA'S ALGORITHM IN PRACTICAL APPLICATIONS

Rob Heemels *In* Univ. Twente, Tomita's Algorithm: Extensions and Applications Sep. 1991 p 79-86 (For primary document see N93-20220 07-61)

Avail: CASI HC A02/MF A02

Some of the requirements of a natural language processing system able to handle grammatical as well as ungrammatical input are discussed. The errors in ungrammatical sentences, at competence level and at the user level, are summarized. The requirements of a robust parsing algorithm are given. The properties of Tomita's algorithm are overviewed. Some problems of solving language ambiguities are presented. The analysis shows that Tomita's algorithm is an attractive algorithm in the field of natural language processing. In particular, the parse forest is a promising candidate for the representation of the analyses. Together with the precompiled parse tables and the breadth first approach which makes online parsing possible, it is a solid basis for a natural language processing module. ESA

N93-20228# Oce Nederland B.V., Venlo. Language and Speech Group.

AN EMPIRICAL COMPARISON OF GENERALIZED LR TABLES

Marc Lankhorst (Universiteit Twente, Enschede, Netherlands.) *In* Univ. Twente, Tomita's Algorithm: Extensions and Applications Sep. 1991 p 87-93 (For primary document see N93-20220 07-61)

Avail: CASI HC A02/MF A02

The table sizes and parsing efficiency of Tomita's algorithm with LR(0), SLR(1), LALR(1), and LR(1) parsing tables are compared on the basis of empirical data. From this comparison, it can be concluded that LALR(1) tables are the best choice regarding parsing time. The reasons for which LR(1) is slower than the other types presented are given. The results show that LR(1) tables are unsuitable for the generalized LR parsing algorithm of Tomita. These tables are much larger than the other three types presented and result in significantly longer parsing times. The use of these tables can result in a 5 to 10 percent improvement in parsing time compared to LR(0). Also, a gain in space efficiency of the same order of magnitude can be achieved. If the size of the parsing tables is a constraint, LR(0) tables are advisable. These are several times smaller than the other types. Another advantage of LR(0) tables is their ease of construction. ESA

N93-20229# Universiteit Twente, Enschede (Netherlands). Dept. of Computer Science.

BOTTOM-UP PARALLELIZATION OF TOMITA'S ALGORITHM

Klaas Sikkel *In its* Tomita's Algorithm: Extensions and Applications Sep. 1991 p 95-103 (For primary document see N93-20220 07-61)

Avail: CASI HC A02/MF A02

A new parallel parsing algorithm is described, which is based on Tomita's generalized LR parser and related to a well known parallel version of Earley's algorithm. It uses a pipeline of processors, one for every word in the sentence. Each processor parses all constituents starting with its 'own' word. While constructing such a partial parse, constituents that were parsed

by other processors higher up the pipeline may be used as terminal symbols. A generalized LR(0) parser, assuming some basic knowledge of LR parsing techniques, is described. The bottom-up parallelization is discussed. The construction of a shared parse forest is presented. ESA

N93-20376# Stanford Univ., CA. Dept. of Computer Science.
ANYTIME DECLARATIVISM Final Technical Report, 1 Nov. 1990 - 30 Apr. 1992
Matthew L. Ginsberg and Nils J. Nilsson Oct. 1992 5 p
(Grant AF-AFOSR-0363-90)
(AD-A258698; AFOSR-92-1023TR) Avail: CASI HC A01/MF A01

The objectives of this grant is to formalize the notion of anytime inference. This work consisted of an extension to Ginsberg's work on multivalued logics, since this earlier work allows arbitrarily finely grained responses to declarative queries. They will also develop a procedure that responds to a declarative query in an anytime fashion, in that it returns the correct answer in the large runtime limit but only approximate answers in shorter times. Both uniform and nonuniform convergence will be addressed. GRA

N93-20377# Stanford Univ., CA. Dept. of Computer Science.
NONMONOTONIC TEMPORAL REASONING Final Report, 15 Apr. 1989 - 14 Apr. 1992
Yoav Shoham 20 Mar. 1992 5 p
(Grant AF-AFOSR-0326-89)
(AD-A258699; AFOSR-92-0326TR) Avail: CASI HC A01/MF A01

In research carried out to this date under this grant they investigated a number of issues, semantical and algorithmic, in the design of agents in a multi-agent environment. The issues that were investigated included the structure of agents' (which they called 'mental state'), the flow of control of agents' activities over time, a particular programming language geared towards controlling agents, and a number of subsidiary computational problems. The researchers have developed a computational framework called agent oriented programming. AOP can be viewed as a specialization of object oriented programming (OOP). The state of an agent consists of components called beliefs, choices, capabilities, commitments, and possibly others; for this reason the state of an agent is called its mental state. The mental state of agents is captured formally in an extension of standard epistemic logics: beside temporalizing the knowledge and belief operators, AOP introduces operators for commitment, choice and capability. Agents are controlled by agent programs, which include primitives for communicating with other agents. In the spirit of speech-act theory, each communication primitives is of a certain type: informing, requesting, offering, and so on. GRA

N93-20383# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
A FRAMEWORK FOR CORPORATE IMPLEMENTATION OF OBJECT-ORIENTED SOFTWARE DEVELOPMENT M.S. Thesis
James M. McVay 1992 208 p
(AD-A258717; AFIT/CI/CIA-92-109) Avail: CASI HC A10/MF A03

The object paradigm is praised by many software engineers as a solution for managing today's complex software development. Its scope covers all phases of a software development life cycle. Applying the paradigm through object-oriented analysis, object-oriented design, and object-oriented programming promises many benefits. Code is easier to reuse. Transitions across the development phases are more understandable. System development costs and time are reduced to yield higher returns on investment. Reaping the benefits of object-oriented software development (OOSD) comes at the expense of major changes. Traditional software developers must covert to a technology conceptually opposed to past practices. The initial costs for converting to OOSD are quite high. New training, tools, and management practices are required. Before fully committing to these changes a company must answer three basic questions: (1) Is the object paradigm useful to software development? (2) If so, how can it be applied to reap the most benefits? (3) What are the impacts on organizational dynamics? GRA

N93-20387# Carnegie-Mellon Univ., Pittsburgh, PA. Software Engineering Inst.
SOFTWARE QUALITY MEASUREMENT: A FRAMEWORK FOR COUNTING PROBLEMS AND DEFECTS Final Report
William A. Florac Sep. 1992 91 p
(Contract F19628-90-C-0003)
(AD-A258556; CMU/SEI-92-TR-22; ESC-TR-92-022) Avail: CASI HC A05/MF A01

This report presents mechanisms for describing and specifying two software measures-software problems and defects-used to understand and predict software product quality and software process efficacy. We propose a framework that integrates and gives structure to the discovery, reporting, and measurement of software problems and defects found by the primary problem and defect finding activities. Based on the framework, we identify and organized measurable attributes common to these activities. We show how to use the attributes with checklists and supporting forms to communicate the definitions and specifications for problem and defect measurements. We illustrate how the checklist and supporting forms can be used to reduce the misunderstandings of measurement results and can be applied to address the information needs of different users. GRA

N93-20402# Carnegie-Mellon Univ., Pittsburgh, PA. Software Engineering Inst.
SOFTWARE DEVELOPMENT RISK: OPPORTUNITY, NOT PROBLEM Final Report
Roger L. VanScoy Sep. 1992 21 p
(Contract F19628-90-C-0003)
(AD-A258743; CMU/SEI-92-TR-30) Avail: CASI HC A03/MF A01

What is risk? What is risk management? What does risk management have to do with software? Noted software expert Tom Gilb says: If you don't actively attack the risks, they will actively attack you Gilb88, p. 72. But what does it mean to actively attack risks? We answer these questions by examining the problems that exist in software development today and presenting the SEI Risk Program approach to turning risk into opportunity. GRA

N93-20406# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
A RADIOSITY APPROACH REALISTIC IMAGE SYNTHESIS SYSTEM M.S. Thesis
Richard L. Remington Dec. 1992 89 p
(AD-A259082; AFIT/GCE/ENG/92D-09) Avail: CASI HC A05/MF A01

The Air Force Institute of Technology (AFIT) has not had the capability to generate photorealistic images. Research effort to implement such a system at AFIT, and to apply knowledge from the particle transport community to this problem is addressed. Investigation into various techniques for generating photorealistic images led to the conclusion that the radiosity method would serve as the foundation for development. This is because of the increased accuracy of the diffuse reflections with the radiosity method and the fact that the images produced with radiosity are view-independent. Two distinct tools to generate photorealistic images are described. The first of these follows the progressive radiosity methodology using ray tracing for form factor calculation. This tool models only diffuse reflections. The second tool is also based on the radiosity method, but does away with the restriction that all surfaces be lambertian diffuse and models specular reflections as well. The design and implementation of the specular radiosity tool uses continuous functions to represent the bidirectional reflectance distribution functions, (BRDF's) and intensities. A new method of representing the BRDF's using a truncated Legendre polynomial expansion is presented. GRA

N93-20409# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
EFFICIENT DERIVATION AND APPROXIMATION OF CEPSTRAL COEFFICIENTS FOR SPEECH CODING M.S. Thesis
Kimberly Ann Limcangco Dec. 1992 91 p
(AD-A259147; AFIT/GCS/ENG/92D-20) Avail: CASI HC A05/MF A01

A new formulation is presented for the calculation of cepstral coefficients directly from measured sine wave amplitudes and frequencies of speech waveforms. Approximations to these cepstral coefficients are shown to be suitable for operation in a real-time speech coding environment. These results were encoded in the C programming language and then evaluated through experiments that were conducted on the McAulay-Quatieri Sinusoidal Transform Coder (STC). GRA

N93-20548# National Inst. for Fusion Science, Nagoya (Japan).
KERNEL OPTIMUM NEARLY-ANALYTICAL DISCRETIZATION (KOND) ALGORITHM APPLIED TO PARABOLIC AND HYPERBOLIC EQUATIONS
Yoshiomi Kondoh (Gunma Univ., Japan.), Yasuo Hosaka (Gunma Univ., Japan.), and Kenji Ishii (Gunma Univ., Japan.) Oct. 1992 74 p Submitted for publication
(NIFS-191; AD-B169728L) Avail: CASI HC A04/MF A01

Two applications of the Kernel Optimum Nearly-analytical Discretization (KOND) algorithm to the parabolic and the hyperbolic type equations are presented in detail to lead to novel numerical schemes with very high numerical accuracy. It is demonstrated numerically that the two dimensional KOND-P scheme for the parabolic type yields quite less numerical error by over 2 - 3 orders and reduces the CPU time to about 1/5 for a common numerical accuracy, compared with the conventional explicit scheme of reference. It is also demonstrated numerically that the KOND-H scheme for the hyperbolic type yields fairly less diffusive error and has fairly high stability for both of the linear- and the nonlinear wave propagations compared with other conventional schemes. Author

N93-20559# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
AN OBJECT-ORIENTED COMPUTER AIDED DESIGN PROGRAM FOR MODERN CONTROL SYSTEMS ANALYSIS M.S. Thesis
Frederick L. Trevino Dec. 1992 250 p
(AD-A259139; AFIT/GE/ENG/92D-36) Avail: CASI HC A11/MF A03

This investigation is a continuation of the ICECAP-PC research project conducted under Prof. Gary B. Lamont at the Air Force Institute of Technology. It is an ongoing development of a public domain Computer Aided Design (CAD) package for Control Engineering students and faculty, with a special emphasis on education. This investigation focuses on three areas. First, an object-oriented environment is specified, designed, and implemented. The functional structure of ICECAP-PC is then converted into an object-oriented structure because object-orientation provides an advanced logic and implementation structure and effectively addresses common software engineering issues. Additionally, a new interface featuring pull-down menus, mouse support, and single stroke access provides optimal user friendliness. Second, the numerical methods used for modern control capabilities are updated providing state of the art numerical capabilities. Third, using a program extension known as a toolbox, a basic MIMO (Multiple Input Multiple Output) faculty is created to augment the MISO capabilities. The MIMO QFT toolbox allows the entry and manipulation of up to a 3x3 MIMO plant matrix of transfer functions for the QFT solution to MIMO control systems problems. GRA

N93-20574# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
VERSION AND TRANSACTION MANAGEMENT IN OSMagic: AN OBJECT-ORIENTED DATABASE IMPLEMENTATION OF THE MAGIC VLSI LAYOUT DESIGN TOOL M.S. Thesis
Gary Michael Lightner Dec. 1992 108 p
(AD-A259138; AFIT/GCS/ENG/92D-07) Avail: CASI HC A06/MF A02

The goal of this thesis was to study the feasibility of using an object-oriented database management system to provide the functionality and performance needed to support a complex computer-aided design tool. We do this by modifying OSMagic, a prototype system of the Magic very large scale integrated (VLSI) circuit design tool implemented on the ObjectStore object-oriented database management system. OSMagic was changed to support three different interfaces to ObjectStore and to work in a networking environment. We then designed and examined the use of version and transaction management models as a means of addressing the weaknesses of the prototype as well as a means of introducing new multi-user capabilities. Throughout the effort, errors discovered in data definition and allocation were corrected, and lessons which pertain to all such conversions were noted. While the current OSMagic is not yet a fully functional version of Magic, the foundation is now in place for achieving this by implementing our more complex transaction model. OSMagic performs as well or better than Magic in about half of the areas tested. Those areas that showed performance degradation were examined with respect to the tradeoffs between added multi-user capabilities and database support versus the severity of the degradation, user perception of the degradation, and the frequency of use for each area. When these tradeoffs were considered along with the expected increased performance of a fully implemented and optimized OSMagic, we conclude that it is highly probable that object-oriented database management systems can provide the functionality and performance needed to support typical computer-aided design applications. GRA

N93-20577# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
FORMALIZING, VALIDATING, AND VERIFYING REAL-TIME SYSTEM REQUIREMENTS WITH REACTO AND VHDL M.S. Thesis
Frank C. Young 15 Dec. 1992 173 p
(AD-A259224; AFIT/GCS/ENG/92D-24) Avail: CASI HC A08/MF A02

We develop a methodology for formalizing, verifying, and validating the requirements specification of real-time systems based on the graphical and formal hierarchical Finite State Machine (FSM) language Reacto. We define a means to quantify time and express real-time constraints in Reacto and a transformation from Reacto to the Very High Speed Integrated Circuit (VHSIC) Hardware Description Language (VHDL). Reacto's high level abstractions, graphical nature, and theorem prover produce efficient, accurate, and easily understood specifications. We use VHDL's event driven simulation capability, concurrency, and temporal operators to thoroughly examine temporal dependencies between the state machine transitions, and to increase simulation power by simulating multiple communicating FSM's. We apply the methodology to two example problems: a cruise control and a lift (elevator) controller. We verify that the state machine specification is consistent and validate the specification using executable simulations in both Reacto and VHDL. We evaluate the methodology against criteria for real-time specification languages and conclude that Reacto and VHDL complement each other well. Together, they abstract the real world well, are clearly understood, verify that the specification and implementation are consistent, are easy to modify, allow requirements tracing, and finally, support specification of concurrency and timing constraints. GRA

N93-20593# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
REAL IMAGE VISUAL DISPLAY SYSTEM M.S. Thesis
James R. Brandt Dec. 1992 90 p
(AD-A259125; AFIT/GEO/ENG/92D-03) Avail: CASI HC A05/MF A01

This thesis investigates a technique for improving the perception of three-dimensionality in images generated by a Silicon Graphics workstation. The technique involves using a spherical mirror into which the graphics from the CRT are projected. A real image of the graphic is formed by the mirror and it appears to be floating at the image plane. The three-dimensional effect is improved by adding reflections or shadows of the displayed object. Additionally, a method of using real objects with computer generated shadows and computer generated objects with real shadows is investigated. This is done in an effort to quantify how far the real world can be integrated with the display as well as to show that the three-dimensionality of the original graphic is enhanced. The optical system is analyzed to show where the images are being formed and to determine the aberrations present in the system. The most noticeable image degradation is due to curvature of field. An improved optical system is proposed that would reduce this effect and increase the size of the display. Finally, this optical device along with the graphic techniques are integrated with two other research efforts. The first integration involves research in binaural sound and focuses on coupling visual and aural cues to create a pseudo synthetic environment. The second integration effort introduces battlefield terrain images into the optical device to enhance the images and functions as a C3I display. GRA

N93-20603*# Illinois Univ., Urbana. Coordinated Science Lab.
ProperCAD: A PORTABLE OBJECT-ORIENTED PARALLEL ENVIRONMENT FOR VLSI CAD
Balkrishna Ramkumar and Prithviraj Banerjee Jan. 1993 44 p
(Grant NAG1-613)
(NASA-CR-192308; NAS 1.26:192308; UILU-ENG-93-2205; CRHC-93-04)
Avail: CASI HC A03/MF A01

Most parallel algorithms for VLSI CAD proposed to date have one important drawback: they work efficiently only on machines that they were designed for. As a result, algorithms designed to date are dependent on the architecture for which they are developed and do not port easily to other parallel architectures. A new project under way to address this problem

is described. A Portable object-oriented parallel environment for CAD algorithms (ProperCAD) is being developed. The objectives of this research are (1) to develop new parallel algorithms that run in a portable object-oriented environment (CAD algorithms using a general purpose platform for portable parallel programming called CARM is being developed and a C++ environment that is truly object-oriented and specialized for CAD applications is also being developed); and (2) to design the parallel algorithms around a good sequential algorithm with a well-defined parallel-sequential interface (permitting the parallel algorithm to benefit from future developments in sequential algorithms). One CAD application that has been implemented as part of the ProperCAD project, flat VLSI circuit extraction, is described. The algorithm, its implementation, and its performance on a range of parallel machines are discussed in detail. It currently runs on an Encore Multimax, a Sequent Symmetry, Intel iPSC/2 and i860 hypercubes, a NCUBE 2 hypercube, and a network of Sun Sparc workstations. Performance data for other applications that were developed are provided: namely test pattern generation for sequential circuits, parallel logic synthesis, and standard cell placement. Author (revised)

N93-20778*# National Aeronautics and Space Administration. Wallops Flight Facility, Wallops Island, VA.
MAPPER: A PERSONAL COMPUTER MAP PROJECTION TOOL
Steven A. Bailey Washington Feb. 1993 39 p
(NASA-TM-4445; Rept-93B00028; NAS 1.15:4445) Avail: CASI HC A03/MF A01

MAPPER is a set of software tools designed to let users create and manipulate map projections on a personal computer (PC). The capability exists to generate five popular map projections. These include azimuthal, cylindrical, mercator, lambert, and sinusoidal projections. Data for projections are contained in five coordinate databases at various resolutions. MAPPER is managed by a system of pull-down windows. This interface allows the user to intuitively create, view and export maps to other platforms. Author

N93-20779*# Research Inst. for Computing and Information Systems, Houston, TX.
EXPERT SYSTEM VERIFICATION AND VALIDATION STUDY Final Report
Scott W. French (International Business Machines Corp., Houston, TX.) and David Hamilton (International Business Machines Corp., Houston, TX.) 28 Aug. 1992 153 p
(Contract NCC9-16; RICIS Proj. AL-16)
(NASA-CR-192175; NAS 1.26:192175) Avail: CASI HC A08/MF A02

Five workshops on verification and validation (V&V) of expert systems (ES) where taught during this recent period of performance. Two key activities, previously performed under this contract, supported these recent workshops (1) Survey of state-of-the-practice of V&V of ES and (2) Development of workshop material and first class. The first activity involved performing an extensive survey of ES developers in order to answer several questions regarding the state-of-the-practice in V&V of ES. These questions related to the amount and type of V&V done and the successfulness of this V&V. The next key activity involved developing an intensive hands-on workshop in V&V of ES. This activity involved surveying a large number of V&V techniques, conventional as well as ES specific ones. In addition to explaining the techniques, we showed how each technique could be applied on a sample problem. References were included in the workshop material, and cross referenced to techniques, so that students would know where to go to find additional information about each technique. In addition to teaching specific techniques, we included an extensive amount of material on V&V concepts and how to develop a V&V plan for an ES project. We felt this material was necessary so that developers would be prepared to develop an orderly and structured approach to V&V. That is, they would have a process that supported the use of the specific techniques. Finally, to provide hands-on experience, we developed a set of case study exercises. These exercises were to provide an opportunity for the students to apply all the material (concepts, techniques, and planning material) to a realistic problem. Derived from text

N93-20788# Grenoble-1 Univ. (France). Lab. Artemis.
PLANE MULTIFLOWS WITH A FIXED NUMBER OF DEMANDS
Andras Sebo Mar. 1992 11 p
(RR-885-M; ETN-93-92714) Avail: CASI HC A03/MF A01

A polynomial algorithm which decides the integer solvability of multicommodity flow problems where the union of 'capacity' and 'demand' edges forms a planar graph, and the number of demand edges is bounded by a prefixed integer k, is presented. The main results of the study is a polynomial algorithm that finds such a multiflow or proves that it does not exist, for arbitary fixed k. A more general polynomial algorithm, namely to decide whether the relation nu(G,T) = tau(G,T) or its weighted generalization holds for the pair (G,T), (where G is not necessarily planar), provided the cardinal of the set T is fixed, is given. ESA

N93-20791# Grenoble-1 Univ. (France). Techniques de l'Informatique, des Mathematiques, de la Microelectronique et de la Microscopie.
REFLECTIONS ON SEGMENTATION [REFLEXIONS SUR LA SEGMENTATION]
Marc Salotti Jan. 1992 49 p In FRENCH
(RR-873-I; ETN-93-92716) Avail: CASI HC A03/MF A01

Principle strategies and problems encountered by tested methods of segmentation are recalled. Images presenting specific problems are studied and different possible approaches are discussed. An attempt to define the apparent basic problem is made: methods so far developed give very fast results but lack essential information for efficient evolution of operations. In carrying out an analogy with an industrial product manufacturing, a specification for an ideal segmentation system is presented, which proves to be that of a general vision system, where the levels are too overlapping to be individually discernable. Several directives relating to efficient information management by strong control of each decision are proposed. One of the consequences of these directives is the differentiation of situations into principle categories. This seems to be required particularly for region and contour detection. The study seems to reveal that it is the informatic (information processing) aspect which has been the most neglected in all the segmentation methods. ESA

N93-20808# Technische Univ., Delft (Netherlands). Vehicle Research Lab.
BOND GRAPH BASED MODELLING USING MACROS: AN INTRODUCTION TO THE PROGRAM BAMMS
C. H. Verheul and H. B. Pacejka 1991 19 p
(MEMT-18; ISBN-90-370-0060-6; ETN-93-92011) Copyright Avail: CASI HC A03/MF A01

A versatile and flexible software package called BAMMS (Bond graph based Algorithm for Modeling Multibody Systems) is presented. The complete program is written in FORTRAN 77. The BAMMS program can be used in various ways to analyze both linear and nonlinear systems. It can perform a time domain simulation or a frequency response analysis and, if desired, it can be used to produce the complete set of equations of a system in any conceivable domain (mechanical, electric, etc.). The method of modeling is described, as well as a number of predefined submodels (macros available in a library for creating a model). The resulting ready to run models are simulated with the simulation package included in BAMMS. ESA

N93-20823# CASA-RI/SME, Tel Aviv (Israel).
PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON CAD/CAM AND AMT. VOLUME 2: CIRP SESSIONS ON TOLERANCING, FOR FUNCTION IN A CAD/CAM ENVIRONMENT
14 Dec. 1989 97 p Conference held in Jerusalem, Israel, 11-14 Dec. 1989; sponsored in cooperation with Israel Ministry of Defense, Israel Ministry of Science and Technology, Rafael, and DASIX Prepared in cooperation with Israel Society for CAD/CAM, Tel Aviv
(ITN-92-85128) Avail: CASI HC A05/MF A02

This is the second of four volumes of papers presented at the conference on CAD/CAM (computer aided design/computer aided manufacturing). The included papers cover tolerancing, part positioning optimization, algorithm development for composite positional tolerance measurement, dimension and tolerancing accuracy in solid modelling systems, three-dimensional statistical model of machined dimensions, automated manufacturing and design axioms, quality inspection and diagnosis, quality assurance, and statistical process control. For individual titles, see N93-20824 through N93-20839.

N93-20824# New South Wales Univ., Kensington (Australia). School of Mechanical and Industrial Engineering.
TOLERANCING FOR FUNCTION IN A CAD/CAM ENVIRONMENT

Leonard Farmer, E. *In* CASA-RI/SME, Proceedings of the International Conference on CAD/CAM and AMT. Volume 2: CIRP Sessions on Tolerancing, for Function in a CAD/CAM Environment 14 Dec. 1989 6 p (For primary document see N93-20823 07-61)
(Paper-C-1-1) Avail: CASI HC A02/MF A02

The role and significance of tolerancing for function in product design and manufacture is first discussed. The nature of tolerance constraints is then considered, together with the need for the optimal selection of tolerances through a cost objective function. The CAD/CAM environment is then treated with reference to developments in drawing practice, dimensioning and tolerancing, preferred design data, process capability data banks, process planning, computer controlled machines and inspection procedures that include co-ordinate measuring machines. ISA

N93-20825# Technion - Israel Inst. of Tech., Haifa. Faculty of Mechanical Engineering.
NEW METHODOLOGIES TOWARD THE INTEGRATION OF TOLERANCING IN CAD/CAM SYSTEMS
Roland Weill *In* CASA-RI/SME, Proceedings of the International Conference on CAD/CAM and AMT. Volume 2: CIRP Sessions on Tolerancing, for Function in a CAD/CAM Environment 14 Dec. 1989 7 p (For primary document see N93-20823 07-61)
(Paper-C-1-2) Avail: CASI HC A02/MF A02

With the actual development of more efficient CAD/CAM systems, the need for integrating tolerancing in CAD/CAM is universally recognized. Basically, the efforts to reach this goal are following two main streams: 1. Recognizing that existing standardization is not suitable for integration in CAD/CAM systems, a large amount of work is spent to build up a more 'computer friendly' tolerancing system. In this field of research, the emphasis is put on tolerancing principles compatible with solid modeler packages and the technical background is essentially based on computerized geometry. 2. Other research, with a background in technological approaches to tolerancing, is endeavoring to develop algorithms replacing the conventional functional gauges used up to now. This approach is of a more modular nature and tries to introduce relevant algorithms in the existing software of the modern CMM (computerized measuring machines). This paper intends to review the state of the art in the field of computer aided tolerancing and to assess the relative merits of both approaches. ISA

N93-20826# Pennsylvania State Univ., University Park. Dept. of Industrial and Management Systems Engineering.
ELEMENTS OF COMPUTER-AIDED TOLERANCE ANALYSIS
E. A. Lehtihet, N. U. Gunasena, and I. Ham *In* CASA-RI/SME, Proceedings of the International Conference on CAD/CAM and AMT. Volume 2: CIRP Sessions on Tolerancing, for Function in a CAD/CAM Environment 14 Dec. 1989 7 p (For primary document see N93-20823 07-61)
(Paper-C-1-3) Avail: CASI HC A02/MF A02

Computer aided tolerancing is a vital component of integrated CAD/CAM; it touches upon areas in design, manufacturing, and inspection. A system dealing with two elements is described: formulation and analysis. Separate modules are used to formulate problems arising in design and manufacturing contexts. Two alternative methods are available to analyze a formulated problem. The proposed analytical method for tolerance analysis is based on the second moment reliability concept and the beta distribution model associated with Bjorke's tolerance control method. Optimal design tolerances are determined by applying a constrained non-linear optimization technique. The second method is based on Monte Carlo simulation. ISA

N93-20827# Neu-Technikum, Buchs (Switzerland).
VECTORIAL TOLERANCING
Adolf Wirtz *In* CASA-RI/SME, Proceedings of the International Conference on CAD/CAM and AMT. Volume 2: CIRP Sessions on Tolerancing, for Function in a CAD/CAM Environment 14 Dec. 1989 5 p (For primary document see N93-20823 07-61)
(Paper-C-1-4) Avail: CASI HC A01/MF A02

Most ISO (International Standards Organization) tolerances are defined as combinations of deviations in diameter, position, and angle; these do not lend themselves to computerized treatment. Vectorial tolerancing uses the mathematical definition of a workpiece shape in terms of appropriate vectors, and the application of tolerances to each vector, within a workpiece coordinate system. For milling and turning, vectorial tolerancing is applied to controlling the position, direction, and size of a surface; form deviations are corrected by using a mathematical description of the generating profile. In slab milling, the correction factor is based on the direction deviation of the milled plane; in face milling, the correction for each tool path is proportional to the tool diameter multiplied by the same factor as that used in slab milling. In turning, two profiles are used to generate the cylinder, and its form and size deviation are described in terms of a polynomial. Machining corrections are related to the coefficients of the polynomial. ISA

N93-20828# Technion - Israel Inst. of Tech., Haifa. Faculty of Mechanical Engineering.
OPTIMIZING POSITIONING OF MECHANICAL PARTS
M. Laloum, I. Dar-El, and Roland Weill *In* CASA-RI/SME, Proceedings of the International Conference on CAD/CAM and AMT. Volume 2: CIRP Sessions on Tolerancing, for Function in a CAD/CAM Environment 14 Dec. 1989 3 p (For primary document see N93-20823 07-61)
(Paper-C-1-5) Avail: CASI HC A01/MF A02

A new approach to determining an acceptable datum system is defined; it uses the isostatism principle and the screw model theory. The isostatism model aims correctly to position six independent points for gripping a rigid part. The screw model applies to very small movement of a rigid part; it resolves each movement into a combination of a rotation element and a translation element. The method is applied to a simple example of a box-shaped part. The method does not converge, but it provides a satisfactory set of points for use in a designer's datum system. ISA

N93-20829# Israel Military Industries, Haifa.
DEVELOPMENT OF ALGORITHMS FOR COMPOSITE POSITIONAL TOLERANCE MEASUREMENT USING COORDINATE MEASURING MACHINES
E. Bratmann and Roland Weill (Technion - Israel Inst. of Tech., Haifa.) *In* CASA-RI/SME, Proceedings of the International Conference on CAD/CAM and AMT. Volume 2: CIRP Sessions on Tolerancing, for Function in a CAD/CAM Environment 14 Dec. 1989 5 p (For primary document see N93-20823 07-61)
(Paper-C-1-6) Avail: CASI HC A01/MF A02

The three steps forming the inspection of the positional requirements of a part are: defining the problem in terms of existing standards; measurement; and determination of whether the measurements comply with the requirements. Computerized measurement has simplified the second step; computerized methods for analysing the results of the measurement are presented. Analytical and iterative solutions to the problem are presented. Computerized methods enable an iterative solution to be obtained relatively quickly. However, greater efficiency is obtained by applying the least squares method first. If the part is rejected by that method, the process must be continued by iteration, beginning at one of the vertex positions defined by application of a mathematical gage, used to define the tolerancing zone. ISA

N93-20830# Nottingham Univ. (England). Dept. of Production Engineering and Production Management.
FUNCTIONAL TOLERANCING IN CAD/CAM
Abdelmadjid Cheikh and Peter F. McGoldrick *In* CASA-RI/SME, Proceedings of the International Conference on CAD/CAM and AMT. Volume 2: CIRP Sessions on Tolerancing, for Function in a CAD/CAM Environment 14 Dec. 1989 4 p (For primary document see N93-20823 07-61)
(Paper-C-2-1) Avail: CASI HC A01/MF A02

Based on the concept of functional tolerancing and the principle of minimum dimensional chains represented by all functional loops within an assembly, tolerance analysis and synthesis models were developed. These models are part of a tolerance technology which totally agrees with the semantics set forth by the ISO (International Standards Organization) philosophy of functional tolerancing and yet, at the same time, represents a general form that can be implemented in a computer based design system to handle various tolerancing problems occurring in industry. ISA

N93-20831# Cranfield Inst. of Tech., Bedford (England). Dept. of Applied Computing and Mathematics.
VALIDITY AND WELL-FORMEDNESS OF DIMENSION AND TOLERANCE INFORMATION IN SOLID MODELING SYSTEMS
Neil S. Bernstein and Kenneth Preiss (Ben Gurion Univ. of the Negev, Beersheva, Israel.) *In* CASA-RI/SME, Proceedings of the International

Conference on CAD/CAM and AMT. Volume 2: CIRP Sessions on Tolerancing, for Function in a CAD/CAM Environment 14 Dec. 1989 8 p (For primary document see N93-20823 07-61)
(Paper-C-2-2) Avail: CASI HC A02/MF A02

Practitioners in the field of mechanical dimensioning and tolerancing are well aware that various combinations of tolerances can give rise to problems of validity and consistency. On the other hand, solid modeling software systems do not provide a capability of analyzing the validity of those data. In order to develop that automated capability, it is necessary to derive suitable representations and algorithms for the problem. Currently, engineers usually succeed in evaluating the validity of tolerance data on a drawing. Nevertheless, there are two major motivations for providing computerized assistance for this task. The first is the growing complexity of mechanical designs; this yields increasing numbers of part and assembly designs that exceed human analytical capabilities. The second is the trend toward concurrent product design; substantial reductions in design time presuppose further automation of the design process. The method of representing dimension and tolerance data in solid models should enable analysis as to whether the data represent a feasible and manufacturable product. In other words, it should be possible to compute whether the data are consistent and valid. This computation should not require excessive computer time or storage. This paper presents the constraint propagation approach, which is a scheme to represent dimension and tolerance data in solid models and is suited to the problem as described above. It then illustrates how this scheme may be employed to evaluate the validity and consistency of those data. ISA

N93-20832# Institut Superieur des Materiaux et de la Construction Mecanique, Saint-Ouen (France). Lab. de Mecatronique.
TOWARD A COMPUTER AIDED FUNCTIONAL TOLERANCING MODEL
B. Charles (Dassault Systemes, Suresnes, France.), A. Clement, A. Desrochers, P. Pelissou, and A. Riviere *In* CASA-RI/SME, Proceedings of the International Conference on CAD/CAM and AMT. Volume 2: CIRP Sessions on Tolerancing, for Function in a CAD/CAM Environment 14 Dec. 1989 7 p (For primary document see N93-20823 07-61)
(Paper-C-2-4) Avail: CASI HC A02/MF A02

This paper presents the basic features of a computer aided functional tolerancing module within CAD/CAM (computer aided design/computer aided manufacturing) software. In this perspective, the main requirements for such a module are first presented. Then some solution proposals are submitted, several of which have already been implemented on a computer. Finally, an example provides a concrete illustration of the suggested dimensioning and tolerancing procedure. Our approach to this problem is based on the concept of Technologically and Topologically Related Surfaces (TTRS) developed in previous articles. ISA

N93-20833# LURPA, Ens de Cachin (France).
TOLERANCE, CHAINS AND SETTING OF MACHINES: THREE DIMENSIONAL STATISTICAL MODEL OF MACHINED DIMENSIONS
A. Castano and P. Bourdet *In* CASA-RI/SME, Proceedings of the International Conference on CAD/CAM and AMT. Volume 2: CIRP Sessions on Tolerancing, for Function in a CAD/CAM Environment 14 Dec. 1989 6 p (For primary document see N93-20823 07-61)
(Paper-C-2-5) Avail: CASI HC A02/MF A02

The possibility to integrate a CNC (computerized numerical control) measuring center into a flexible production system enables us to obtain series of three-dimensional data which we must be able to interpret from the statistical point of view. These results can immediately be used: to determine the machined dimensions in order to conform with the original drawing; to inspect the machine tool adjustment during machining and manufacturing; to analyze the behavior of the machined workpiece in its fixture. This is possible only if we have a three-dimensional model to represent the dimensions actually obtained on a series of workpieces. The statistical models used to determine manufacturing dimensions and to inspect the machine-tool adjustment validity are uni-dimensional. There is no method to enable the behavior of the workpiece in its manufacturing fixture to be analyzed from results obtained after machining. The purpose of this study is to define a three-dimensional model of the dimensions obtained on a workpiece available for these different applications. The statistical model proposed allows us to take into account the defects in shape, orientation, wear, position and adjustment. The analysis method used to determine these different parameters is defined, as well as the method of determination of the position of the associated frame relative to any surface. This position is directly linked to the method of positioning the workpiece during machining and is computed so that the parameters can be independent. ISA

N93-20834# Massachusetts Inst. of Tech., Cambridge.
TOLERANCING IN THE CONTEXT OF THE AUTOMATED MANUFACTURING AND THE DESIGN AXIOMS
Nam P. Suh and Shinya Sekimoto (Toshiba Corp., Kawasaki, Japan.) *In* CASA-RI/SME, Proceedings of the International Conference on CAD/CAM and AMT. Volume 2: CIRP Sessions on Tolerancing, for Function in a CAD/CAM Environment 14 Dec. 1989 10 p (For primary document see N93-20823 07-61)
(Paper-C-2-6) Avail: CASI HC A02/MF A02

In design/manufacturing, tolerances are specified for various functional requirements and design parameters. The purpose of specifying tolerances is to satisfy the functional requirements of a given product and to maximize the manufacturing productivity. In the manufacturing process, the upper and lower bounds on tolerances are given by the need to satisfy the independence of functional requirements and to minimize the information content (and thus complexity). This paper discusses the role of tolerancing from the point of view of the design axioms and manufacturing operations. ISA

N93-20835# Purdue Univ., West Lafayette, IN. School of Industrial Engineering.
ON IMPROVING ACCURACY OF MACHINING CENTERS
Moshe M. Barash, R. Venugopal (Bell Telephone Labs., Inc., Columbus, OH.), and S. K. Lee (Automotive Components Ltd., Kyungbook, Republic of Korea.) *In* CASA-RI/SME, Proceedings of the International Conference on CAD/CAM and AMT. Volume 2: CIRP Sessions on Tolerancing, for Function in a CAD/CAM Environment 14 Dec. 1989 5 p (For primary document see N93-20823 07-61)
(Contract N00014-83-K-0385)
(Paper-C-3-1) Avail: CASI HC A01/MF A02

The effect of internal heat sources, primarily electric motors and spindle bearings, on the distortion and errors of the structure (frame) of a 3-axis machining center was investigated. Three methods were employed: analytical-numerical analysis using finite elements, calibration with a laser interferometer measuring system, and calibration with an independently calibrated 'master part' called here 'metrology pallet' and a touch probe. A machining test using the latter was also conducted. The maximum volumetric error in all the cases could be reduced to approximately the same value which was less than half of the uncorrected error. ISA

N93-20836# Technical Univ. of Cracow (Poland).
PROBLEMS OF QUALITY INSPECTION AND DIAGNOSING IN MODERN MANUFACTURING SYSTEMS
Leszek Nawara and Marek Kowalski *In* CASA-RI/SME, Proceedings of the International Conference on CAD/CAM and AMT. Volume 2: CIRP Sessions on Tolerancing, for Function in a CAD/CAM Environment 14 Dec. 1989 7 p (For primary document see N93-20823 07-61)
(Paper-C-3-2) Avail: CASI HC A02/MF A02

Effective control of a technological process is possible only if a very quick information system about the quality of the actually performed production process is operating. From this point of view, a close cooperation between production and quality inspection is necessary. Such a cooperation may be reached using coordinate measuring machines (CMM) for the measurements. Simultaneously, some basic problems relating to the measuring conditions and strategy should be solved. The presentation of these conditions, emphasizing the above-mentioned problems, and solving some of them, is the subject of this report. The conditions needed for the introduction of CMM's in modern, especially flexible manufacturing systems, are given. The integration of CMM's and material flow consists, inter alia, of the adaptation of CMM's to cooperate with the handling and transport systems. The integration of CMM's and information flow is done by coupling the CMM computer with the host computer of the system. Some examples of such an integration are given. ISA

N93-20837# Rafael Armament Development Authority, Haifa (Israel).
QUALITY ASSURANCE IN THE FUTURE INDUSTRIAL PLANT **c38**
Avner Halevy *In* CASA-RI/SME, Proceedings of the International Conference on CAD/CAM and AMT. Volume 2: CIRP Sessions on

Tolerancing, for Function in a CAD/CAM Environment 14 Dec. 1989 2 p (For primary document see N93-20823 07-61)
(Paper-C-3-3) Avail: CASI HC A01/MF A02

Statistical tools for industrial use are usually associated with statistical quality control. This, in turn, is usually associated with sampling plans, control charts, or some other tool for process control. However, quality must be incorporated into the product by design. No control, efficient as it may be, can improve a product's characteristics, i.e., its quality. Statistical tools used in designing for quality were developed in England in the 30's. Certain varieties of these tools are widely used in Japan, but have not yet been adopted in the West in any appreciable volume. The designer uses these tools in the understanding that lack of quality incurs actual losses to both the producer and the user. The loss is measured with the help of a loss function which is to be minimized, using techniques of statistical design of experiments. A production plant wishing to survive in the future will have to employ systematic and efficient processes of design for quality during the development phase of the products. ISA

N93-20838# Technion - Israel Inst. of Tech., Haifa. Faculty of Industrial and Management Engineering.
STATISTICAL PROCESS CONTROL (SPC) IN FMS/CIM SYSTEMS c63
Gideon Halevi *In* CASA-RI/SME, Proceedings of the International Conference on CAD/CAM and AMT. Volume 2: CIRP Sessions on Tolerancing, for Function in a CAD/CAM Environment 14 Dec. 1989 8 p (For primary document see N93-20823 07-61)
(Paper-C-3-4) Avail: CASI HC A02/MF A02

Statistical Process Control (SPC) is a technique for error prevention rather than error detection. With SPC, products will be of the required quality because they are manufactured properly and not because they are inspected. Thus, SPC increases productivity by continuous process improvement and by reducing scrap and rework. Other methods that aim at increasing productivity such as FMS, CIM, or JIT turn to hardware flexibility, integrating information flow, or by reducing inventory. Seldom does a system turn to technological flexibility to accomplish the desired results. SPC is accomplished by technological means (statistics for detection and technology for prevention). The technology can be applied by a manual cause and effect study or automatically by an appropriate Generative Process Planning Program (GPPP). This paper describes the specifications for a GPPP module to be employed in SPC and the method to construct such a GPP program. Furthermore, the paper will show that the similar requirements and programs are mandatory in Flexible Manufacturing Systems (FMS) if a true flexibility is to be accomplished in software as well as in hardware, and in Computer Integrated Manufacturing (CIM) for incorporating technology in production management activities. ISA

N93-20839# Rafael Armament Development Authority, Haifa (Israel).
TOTAL QUALITY ASSURANCE c38
E. Louzon *In* CASA-RI/SME, Proceedings of the International Conference on CAD/CAM and AMT. Volume 2: CIRP Sessions on Tolerancing, for Function in a CAD/CAM Environment 14 Dec. 1989 3 p (For primary document see N93-20823 07-61)
(Paper-C-3-5) Avail: CASI HC A01/MF A02

Quality, cost, and schedule are three factors affecting the competitiveness of a company; they require balancing so that products of acceptable quality are delivered, on time and at a competitive cost. Quality costs comprise investment in quality maintenance and failure costs which arise from failure to maintain standards. The basic principle for achieving the required quality at minimum cost is that of prevention of failures, etc., through production control, attention to manufacturing practices, and appropriate management and training. Total quality control involves attention to the product throughout its life cycle, including in-service performance evaluation, servicing, and maintenance. ISA

N93-20844# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).
CIME OF MICROSYSTEMS
Helmut Zinner 1992 15 p Presented at CIM Europa Annual Conference, Birmingham, England, 27-29 May 1992
(MBB-Z-0428-92-PUB; ETN-92-92755) Avail: CASI HC A03/MF A01

A concept for an integrated CIM methodology for microsystems is presented. Microsystem technology is defined and its objectives outlined: microsystems are systems that combine different basic technologies such as electronics, mechanics, and optics, that have functional structures of the size of several micrometers, and that are optimized as whole systems. Advantages over existing solutions, especially for SME's, are considered. The fabrication of microsystems requires capabilities in the fields of process technologies, of design and simulation, and the so called systems technologies that enable the topdown development of these systems and their integration into products. The state of the art was investigated. Recommendations for further research and for the management of this innovative technology is derived from this analysis. ESA

N93-20851# Technische Univ., Delft (Netherlands). Faculty of Mathematics and Informatics.
SPECIFYING AND MODIFYING THE GRAPHICS MANAGER AND THE GRAPHIC CALCULATOR IN D2M2edit
Johan Versendaal 1991 43 p
(Rept-91-56; ETN-93-92018) Copyright Avail: CASI HC A03/MF A01

A detailed description of the specifications of the Graphic Calculator Highly Interactive Computer System (HICS) is presented. The modifications of the Graphics Manager, the detailed specifications of the Graphic Calculator, and the modifications of the Graphic Calculator are discussed. ESA

N93-20859# Institut National de Recherche d'Informatique et d'Automatique, Le Chesnay (France). Programme 2: Calcul Symbolique, Programmation et Genie Logiciel.
MODULA-2* AND ITS COMPILATION
Michael Philippsen (Karlsruhe Univ., Germany.), Walter F. Tichy (Karlsruhe Univ., Germany.), and Christian G. Herter (Karlsruhe Univ., Germany.) Apr. 1991 15 p
(INRIA-RR-1421; ETN-93-9264199) Avail: CASI HC A03/MF A01

Major advantages of MODULA-2* over the data parallel programming model are described. MODULA-2*, an extension of MODULA-2, is a programming language for writing highly parallel programs in a machine independent, problem oriented way. The novel attributes of MODULA-2* are that programs are independent of the number of processors, independent of whether memory is shared or distributed, and independent of the control modes (SIMD or MIMD) of a parallel machine. The principles of translating MODULA-2* programs to MIMD and SIMD machines are presented and the lessons learned from the first compiler, targeting the connection machine, are discussed. Important architectural principles required of parallel computers to allow for efficient, compiled programs are given in conclusion. ESA

N93-20863# Technische Univ., Delft (Netherlands). Faculty of Mathematics and Informatics.
A BUILD-UP VARIANT OF THE PATH-FOLLOWING METHOD FOR LP
D. denHertog, C. Roos, and T. Terlaky Jun. 1991 15 p Sponsored by Shell
(Contract OTKA-2116)
(Rept-91-47; ETN-93-92015) Copyright Avail: CASI HC A03/MF A01

A strategy for building up the Linear Program (LP) while using a path following method is proposed. The method starts with a (small) subset of the constraints and follows the corresponding central path until the iterate is close to (or violates) one of the constraints. Then this constraint is added to the current system. This process is repeated until an optimal solution is reached. If a constraint is added to the current system, the central path will change of course. The effect of the barrier function value if a constraint is added is analyzed. An upper bound is given for the number of iterations needed to return to the new path. In the worst case, the complexity is proved to be the same as the complexity of the standard path following method. In practice, this build up scheme is likely to save computational effort. ESA

N93-20872# Institut National de Recherche d'Informatique et d'Automatique, Le Chesnay (France). Programme 4: Robotique, Image et Vision.
DYNAMIC LOCATION IN AN ARRANGEMENT OF LINE SEGMENTS IN THE PLANE
Olivier Devillers, Monique Teillaud, and Mariette Yvinec (Centre National de la Recherche Scientifique, Paris, France.) Nov. 1991 19 p Sponsored in part by EEC
(INRIA-RR-1558; ETN-93-92667) Avail: CASI HC A03/MF A01

An algorithm which dynamically maintains the trapezoidal map of an

arrangement of line segments is described. This algorithm is a generalization of an influence graph data structure used to deal with the semidynamic case. The complexity results are randomized: the insertion sequences are supposed to be evenly distributed along the n possible sequences of n segments, and when an object is deleted, the supposition that it can be any of the already inserted objects with the same probability is made. Under these assumptions the algorithm needs O(n + a) expected space, O(log n + a/n) expected insertion time, O((1 + a/n) log log n) expected deletion time and O(log n) time to locate any query point in the arrangement, where a is the current size of the arrangement and n the current number of segments. ESA

N93-20895*# University of South Florida, Tampa. Dept. of Civil Engineering and Mechanics.

EFFECT OF DESIGN SELECTION ON RESPONSE SURFACE PERFORMANCE Final Report

William C. Carpenter 18 Feb. 1993 180 p

(Grant NAG1-1378)

(NASA-CR-192275; NAS 1.26:192275) Avail: CASI HC A09/MF A02

The mathematical formulation of the engineering optimization problem is given. Evaluation of the objective function and constraint equations can be very expensive in a computational sense. Thus, it is desirable to use as few evaluations as possible in obtaining its solution. In solving the equation, one approach is to develop approximations to the objective function and/or restraint equations and then to solve the equation using the approximations in place of the original functions. These approximations are referred to as response surfaces. The desirability of using response surfaces depends upon the number of functional evaluations required to build the response surfaces compared to the number required in the direct solution of the equation without approximations. The present study is concerned with evaluating the performance of response surfaces so that a decision can be made as to their effectiveness in optimization applications. In particular, this study focuses on how the quality of approximations is effected by design selection. Polynomial approximations and neural net approximations are considered. Derived from text

N93-20899# Institut National Polytechnique, Grenoble (France). Lab. de Genie Informatique.

EFFICIENT COMPILATION OF A SYNCHRONOUS DECLARATIVE LANGUAGE: LUSTRE-V3 CODE GENERATOR Ph.D. Thesis [COMPILATION EFFICACE D'UN LANGAGE DECLARATIF SYNCHRONE: LE GENERATUER DE CODE LUSTRE-V3]

Pascal Raymond 1991 146 p In FRENCH

(ETN-93-92679) Avail: CASI HC A07/MF A02

The production of sequential code from the dataflow synchronous language LUSTRE is presented. The main difficulty comes from the declarative style of the language: there is no explicit control statement in a LUSTRE program, so the whole control structure must be synthesized by the compiler. This synthesis consists in building a finite automaton by simulating the behavior of boolean variables. The execution of the resulting code is efficient: the boolean operations are performed at compile time. The exhaustive aspect of this method can cause a real explosion of the code size. This problem can be due to the intrinsic complexity of the program source; in this case, a compromise between execution time and memory size has to be found. The explosion can also be caused by the building method, which often produces non-minimal automata. An algorithm which always generates minimal automata is developed. This algorithm requires a lot of symbolic manipulations of boolean functions, implemented by using binary decision diagrams. ESA

N93-20921# Grenoble-1 Univ. (France). Lab. de Genie Informatique.

OBJECT-ORIENTED DESIGN. MECANO: A METHOD AND AN ENVIRONMENT FOR OBJECT-ORIENTED APPLICATIONS CONSTRUCTION Ph.D. Thesis [CONCEPTION PAR OBJETS. MECANO: UNE METHODE ET UN ENVIRONNEMENT DE CONSTRUCTION D'APPLICATIONS PAR OBJETS]

Xavier Girod 1991 255 p In FRENCH

(ETN-93-92682) Avail: CASI HC A12/MF A03

MECANO (French acronym for a method and an environment of object-oriented applications construction) is presented. MECANO is based on the object oriented programming model and provides new concepts for the software design phase in order to improve evolutivity and reusability. The inheritance taxonomy provides semantics to the class/superclass relationship and improves the understandability of the inheritance graph. The structuring entity called domain is based on this taxonomy. Domains are specialization/realization hierarchies containing reusable components. Two structuring entities are also introduced: composites and applications which provide complementary ways for class organization. A graphic formalism and a design process to define other aspects of the MECANO design method are given. An example showing how the method leads to more flexible and reusable designs is presented. ESA

N93-20943# Grenoble-1 Univ. (France). Lab. de Modelisation et Calcul.

SURFACE/SURFACE INTERSECTION ON A PROCESSOR MESH [INTERSECTION SURFACE/SURFACE SUR UNE GRILLE DE PROCESSEURS]

A. Kaufmann Nov. 1991 29 p In FRENCH

(RR-864-M; ETN-93-92697) Avail: CASI HC A03/MF A01

The surface/surface intersection, a useful problem in computer aided geometric design, is investigated on a mesh connected computer, using a method of Bezier subdivision. This method is quite different to the surface/plane intersection. The need of sharing look-up tables and the Bezier nets is considered. These sharings are not independent. A method to solve this problem and other relevant problems is discussed. Experimental results, obtained with a Meganode (128 transputer) are included. Performances, and remarks about the interest to stop, or not, the sharing of Bezier nets after a given time is summarized. ESA

N93-21033# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

ON THE COMPARISON OF SEQUENCES: ANALYZING BEHAVIOURAL ASPECTS OF COURSEWARE DEVELOPMENT AND USE

Cornelis Hoede Jan. 1992 16 p

(MEMO-1030; ETN-93-92458) Avail: CASI HC A03/MF A01

Sequences of acts, as seen by van Schaik as representations of the behavior of courseware developers, are addressed. Ideal sequences are all those sequences that can be generated by a grammar in which the production rules represent correct acts. The deviation of an observed sequence from the set of ideal sequences is calculated by Baas and van Schaik by a global comparison of the observed sequence and the ideal sequences. This leads to large computation times. The assumption of global comparison is discussed and an alternative calculation of the deviation is suggested that reduces the computation time considerably. ESA

N93-21035# Utrecht State Univ. (Netherlands). Dept. of Computer Science.

AN O(N SQUARED) MAXIMAL PLANARIZATION ALGORITHM BASED ON PQ-TREES

Goos Kant Jan. 1992 24 p

(Contract EEC-3075)

(RUU-CS-92-03; ETN-93-92803) Avail: CASI HC A03/MF A01

The problem of how to delete a number of edges from a nonplanar graph G4 such that the resulting graph G4 is maximal planar, that is, an edge e is a member of G - G' to G' without destroying planarity, is investigated. The algorithm is a corrected and more generalized version of the maximal planarization algorithm of Jayakumar et al., based on the planarity testing algorithm using PQ trees of Booth and Lueker. The algorithm can be implemented to run in O(n squared) time. ESA

N93-21037# Technische Univ., Delft (Netherlands). Faculty of Technical Mathematics and Informatics.

DEVELOPMENT OF SEMANTIC METAMODELS FOR OBJECT ORIENTATION [DE ONTWIKKELING VAN SEMANTISCHE METAMODELEN VOOR OBJECTASSOCIATIE]

J. A. Bakker 1991 30 p In DUTCH

(Rept-91-83; ETN-93-91833) Copyright Avail: CASI HC A03/MF A01

New concepts were developed for the modeling of object association, i.e., the grouping of objects that fulfill given condition(s), as an addition to data modeling concepts. The present metamodels contain concepts that make it possible to add definition of groups (associations) to the object types and attribute of a data model. The characteristics of the iterative metamodels for object association are outlined. ESA

N93-21045# National Inst. of Standards and Technology, Gaithersburg, MD. Applied and Computational Div.
A TRUNCATED SQP ALGORITHM FOR LARGE SCALE NONLINEAR PROGRAMMING PROBLEMS
Paul T. Boggs, Jon W. Tolle (North Carolina Univ., Chapel Hill.), and Anthony J. Kearsley (Rice Univ., Houston, TX.) Aug. 1992 14 p
(PB92-226299; NISTIR-4900) Avail: CASI HC A03/MF A01

The inequality constrained non-linear programming problem and a sequential quadratic programming algorithm for its solution are considered. Two aspects of the general procedure, namely, the approximate solution of the quadratic program, and the need for an appropriate merit function are of primary concern. An (iterative) interior-point method for the quadratic programming subproblem that, no matter when it is terminated, yields a descent direction for a suggested new merit function is described. An algorithm based on ideas from trust region and truncated Newton methods is suggested and some of their preliminary numerical results are discussed. GRA

N93-21051# Grenoble-1 Univ. (France). Techniques de l'Informatique, des Mathematiques, de la Microelectronique et de la Microscopie.
GENERALIZED 3D VORONOI DIAGRAM: FIRST RESULTS [DIAGRAMME DE VORONOI GENERALISE 3D: PREMIERS RESULTATS]
Etienne Bertin and Jean-Marc Chassery Mar. 1992 24 p In FRENCH
(RR-879-M; ETN-93-92708) Avail: CASI HC A03/MF A01

A theoretical discussion on separator equations is given and an approximate solution to representing the generalized 3D (three dimensional) Voronoi diagram with the aid of the 3D pinpoint Voronoi diagram is given. The computation time of the algorithms is relatively long. A specific type of 'divide and conquer' algorithm for the object interior and incremental for the exterior should also be used. The algorithmic difficulties seem to be huge, particularly for quadric intersection calculation and the problem of convex envelope construction in 3D. A direct application of the 3D Voronoi diagram is the construction of the skeleton, the exoskeleton and the SKIZ (Skeleton by Influence Zone) of 3D objects. ESA

N93-21060# Grenoble-1 Univ. (France). Lab. de Modelisation et Calcul.
NUMERICAL MODELING AND OPTIMIZATION FOR THE RECONSTRUCTION OF A POLYHEDRON FROM ITS GENERALIZED GAUSSIAN IMAGE Ph.D. Thesis [MODELISATION ET OPTIMISATION NUMERIQUE POUR LA RECONSTRUCTION D'UN POLYEDRE A PARTIR DE SON IMAGE GAUSSIENNE GENERALISEE]
Hamid Zouaki 1991 92 p In FRENCH
(ETN-93-92683) Avail: CASI HC A05/MF A01

An algorithm to reconstruct the surface shape of a convex polyhedron from its extended gaussian image is presented. This algorithm is based on Minkowski's theorem. This reconstruction is done by solving a convex optimization problem. The extended gaussian image is defined as representation of convex objects. The most important properties are investigated. The method of reconstruction and improvements which make the algorithm more efficient are given. The general scheme of the algorithm is given along with some comments on numerical aspects. This method is illustrated by some examples and it is shown that the extended gaussian image can be used as a way to sculpt objects. ESA

N93-21063# Grenoble-1 Univ. (France). Techniques de l'Informatique, des Mathematiques, de la Microelectronique et de la Microscopie.
THREE DIMENSIONAL REPRESENTATION AND 3D RECONSTRUCTION USING TWO DIMENSIONAL SECTIONS Ph.D. Thesis [REPRESENTATION TRIDIMENSIONNELLE ET RECONSTRUCTION 3D A PARTIR DE COUPES 2D]
Franck Rolland 1991 210 p In FRENCH
(ETN-93-92686) Avail: CASI HC A10/MF A03

Methods and steps to perform three dimensional reconstruction from two dimensional sequential cross sections are defined. The models applied in the analysis of two and three dimensional structures are summarized. A three dimensional skeleton method to obtain two or one dimensional basic structures is presented. Reconstruction and the development of the medium line graphic based on structural inference processes are included. The relationship between graphics is analyzed by a heuristic process. The medium line method allows reconstruction of three dimensional bodies by superposition of two dimensional inferred structures. Some results and their consequences are summarized. ESA

N93-21066# Technische Hochschule, Darmstadt (Germany). Fachbereich Informatik.
REFERENCE MODEL FOR THE DESCRIPTION OF GRAPHIC DATA PROCESSING AND FOR THE INTEGRATION OF GRAPHIC SYSTEMS WITH OTHER DATA PROCESSING FIELDS Ph.D. Thesis [REFERENZMODELL ZUR BESCHREIBUNG DER GRAPHISCHEN DATENVERARBEITUNG UND ZUR INTEGRATION GRAPHISCHER SYSTEME MIT ANDEREN BEREICHEN DER DATENVERARBEITUNG]
Jochem Poller 1990 177 p In GERMAN
(ETN-93-93417) Avail: CASI HC A09/MF A02

A model is presented which outlines the relations between already existing systems and reference models and describes their interfaces. The reference model developed allows the description of the existing standards and to identify their errors and problems. The reference model of graphic data processing is described in detail. The emphasis is put on the concepts for formal description, such as the concept of components and framework. A subdivision in layers of graphic data processing is presented. The relations of the graphic system with its applications and with other duties are described on the basis of the reference model. It is shown that an integration without a suitable reference model is not possible. ESA

N93-21167# Grenoble-1 Univ. (France). Lab. Artemis.
PROXIMAL TECHNIQUES FOR CONVEX PROGRAMMING
Philippe Mahey, Said Oualibouch, Van Hien Nguyen (Facultes Univ. Notre-Dame de la Paix, Namur, Belgium.), and Dinh Tao Pham (Institut National des Sciences Appliquees, Routen, France.) Feb. 1992 53 p
(RR-877-M; ETN-93-92706) Avail: CASI HC A04/MF A01

Three studies on proximal techniques for convex programming are presented. The theoretical study of the convergence of the projected proximal method is addressed and certain results of Brezis on the sum of maximal monotone operators are generalized. The application of the projected proximal method to different separable convex optimization problems is described. This results in a family of decomposition algorithms that can be interpreted as separable augmented Lagrangian methods. The proximal decomposition method in the monotone operator graph is presented. This algorithm is shown to be equivalent to the inverse partial Spingarn method in the case of the minimization of a convex function on a subspace. An optimal value of the scale factor is shown to exist, which confirms the numerical experiments. ESA

N93-21170# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
REDESIGNING THE WINDOW PROTOCOL: THE BLOCK ACKNOWLEDGEMENT REVISITED
Anneke A. Schoone Feb. 1992 18 p
(Contract EEC-3075)
(RUU-CS-92-04; ETN-93-92804) Avail: CASI HC A03/MF A01

A review on the block acknowledgement protocol is given. Brown, Gouda, and Miller claim that they have redesigned the window protocol such that it tolerates both message loss and message disorder, while using only bonded sequence numbers. They suggest an implementation of the timeout condition of the protocol by means of timers. The consequences of an implementation with timers is analyzed and the implementation of the protocol as specified is shown to not always be possible by means of timers. This is due to the fact that in the original protocol it is not observable for the sender whether the timeout conditions holds or not. The protocol is slightly modified such that an implementation with timers is possible, and proved to be correct. ESA

N93-21184 Politecnico di Milano (Italy). Dipt. di Elettronica e Informazione.
DESIGN AND IMPLEMENTATION OF LOGRES
F. Cacace, S. Ceri, and L. Tanca 1992 49 p Sponsored in part by CNR and Commission of the European Communities
(Rept-92-040; ETN-93-93037) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

A new generation database system integrating deductive and object oriented databases is presented. The data model of LOGRES supports structural and semantic complexity through a rich collection of concepts

from object oriented models. The rule language of LOGRES allows for the manipulation of complex objects, and the definition of active constraints. The application of rules to database states is controlled by means of qualifiers, which dictate the side effects of rules; qualifiers are the unique procedural feature of LOGRES, otherwise a fully declarative language. The LOGRES data model and language are illustrated and their prototype implementation are described. ESA

N93-21221# National Inst. of Standards and Technology, Gaithersburg, MD.

SOFTWARE QUALITY ASSURANCE: DOCUMENTATION AND REVIEWS

Delores R. Wallace, Wendy W. Peng, and Laura M. Ippolito Sep. 1992 61 p

(PB93-113694; NISTIR-4909) Avail: CASI HC A04/MF A01

The study examines the contents of a software quality assurance standard for nuclear applications. The study includes recommendations for the documentation of software systems. Background information on the standard, documentation, and the review process is provided. The report includes an analysis of the applicability, content, and omissions of the standard and compares it with a general software quality assurance standard produced by the Institute for Electrical and Electronics Engineering. Information is provided for the content of the different types of documentation. The report describes information for use in safety evaluation reviews. Many recommendations in the report are applicable for software quality assurance in general. GRA

N93-21239# National Inst. of Standards and Technology, Gaithersburg, MD. Information Systems Engineering Div.

DATABASE LANGUAGE SQL: INTEGRATOR OF CALS DATA REPOSITORIES

Leonard Gallagher and Joan Sullivan Sep. 1992 64 p Sponsored by Office of the Deputy Assistant Secretary of Defense for Total Quality Management

(PB93-113637; NISTIR-4902) Avail: CASI HC A04/MF A01

The Computer-aided Acquisition and Logistic Support (CALS) program of the U.S. Department of Defense requires a logically integrated database of diverse data. Previous reports to CALS have identified the importance of Database Language SQL and its distributed processing counterpart, Remote Database Access (RDA), for their ability to address a significant portion of CALS data management requirements. The new 'Object SQL' facilities proposed for inclusion in SQL3 is presented, SQL abstract data types (ADT's) are introduced, the benefits of 'generic ADT packages' for management of application specific objects are discussed, and a new external repository interface (ERI) that would allow integration of heterogenous, non-SQL data repositories is proposed. The appendices give the current status and applicability of national, international, and Federal standards for SQL and RDA, discuss the availability of conforming implementations, and present the status of the National Institute of Standards and Technology (NIST) SQL and RDA validation testing. GRA

N93-21262# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

A NOVEL APPROACH TO GRAPHICS

Tomaso Poggio and Roberto Brunelli Feb. 1992 19 p

(Contract N00014-91-4038)

(AD-A259337; AI-M-1354; CBIP-P-71) Avail: CASI HC A03/MF A01

We propose a new, memory-based approach to graphic animation of 2D and 3D objects. Instead of the standard paradigm for 3D modeling, physical simulation and rendering, we propose to use a set of 2D views to synthesize a network that generates desired images and image sequences. The approach is based on a new approximation technique which can be regarded as a scheme for learning from examples. GRA

N93-21291# Texas Univ., Austin. Center for Transportation Research.

INTERACTIVE GRAPHICS INTERSECTION DESIGN SYSTEM: FIRST-STAGE DEVELOPMENT

Thomas W. Rioux, Robert F. Inman, Charles H. Berry, Jr., Clyde E. Lee, and Randy B. Machemehl Nov. 1991 54 p Sponsored by Federal Highway Administration and Texas Dept. of Transportation

(PB92-227693; CTR-3-8/18-89/1-1139-1F; RR-1139-1F; FHWA/TX-92+1139-1F) Avail: CASI HC A04/MF A01

The reported research establishes a versatile foundation for initial and future development of an Iteractive Graphics Intersection Design System (IGIDS). Functional requirements, basic capabilities, and computer program structure for the system are established. Candidate hardware and software system components were identified and evaluated for selection of suitable examples used in the first-stage development. An extensive amount of programming was accomplished interfacing the example graphics engine (MicroStation), database engine (Informix), and intersection analysis program (TEXAS Model for Intersection Traffic). Provisions were incorporated to allow implementation of several other computer applications as the need arises. The research demonstrates the feasibility of integrating computer hardware and software components into a user-friendly interactive graphics system supporting the intersection designer. GRA

N93-21303# Technische Hochschule, Darmstadt (Germany). Fachbereich Physik.

SOLUTION OF QUADRATIC DISTRIBUTED CONTROL PROBLEMS BY OPTIMIZATION METHODS Ph.D. Thesis [LOESUNG QUADRATISCHER VERTEILTER KONTROLLPROBLEME DURCH OPTIMIERUNGSMETHODEN]

Min Sha 1990 113 p In GERMAN Sponsored by DFG

(ETN-93-93409) Avail: CASI HC A06/MF A02

The controllability of special vibrational systems is examined. The processes for the computation of the solution of a determined class of optimization problems is considered, in relation with the standard minimal control of special vibrational problems. The generalized Lagrange multiplier process is used as the continuation of the penalty method. The numerical result obtained by the penalty method is used as the starting value of the improved process. A special process is developed, in order to solve optimization problems for a quadratic F function. It allows more rapid and economical computation. Convergence problems produced by the discretization of the optimization problem are discussed. ESA

N93-21348# National Inst. of Standards and Technology, Gaithersburg, MD. Computer Systems Lab.

INTRODUCTION TO GRAPHICAL USER INTERFACES AND THEIR USE BY CITIS

Susan Q. Sherrick Jul. 1992 25 p

(PB92-213404; NISTIR-4876) Avail: CASI HC A03/MF A01

A Graphical User Interface (GUI) is a powerful tool that is used for simplifying a computing environment. This paper provides a tutorial on the various meanings of the term GUI, describes the usefulness of GUI's, identifies problems with GUI's, and recommends that the X Window System GUI be used within the Contractor Integrated Technical Information Service (CITIS) specification. The term 'GUI' can have various meanings in different contexts. In order to provide a framework for discussion in the paper, a GUI is characterized as having at least one of the following components: Display Manager Program, Application User Interface, or Application Programmer's Interface (API). One of the major problems with GUI's is the potential lack of portability of an application developed to run using a particular GUI. The X Window System provides a means of overcoming the problem because applications developed using the X Window API may be run using almost all other GUI's. Consequently, the X Window System can be used by CITIS to provide easy to use applications which may be used on almost all GUI platforms. GRA

N93-21351# National Inst. of Standards and Technology, Gaithersburg, MD. Computer Systems Lab.

CONFORMANCE TEST SPECIFICATION FOR COBOL INTRINSIC FUNCTION MODULE

Carmelo Montanez-Rivera and L. Arnold Johnson Jul. 1992 113 p

(PB92-229178; NIST/SP-500/203) Avail: CASI HC A06/MF A02; SOD HC

The document contains test specifications for the COBOL Intrinsic Functions Module of the Federal Information Processing Standard (FIPS) Programming Language COBOL, FIPS PUB 21-3 (ANSI X3.23-1985, and Addendum ANSI X3.23A-1989). The document serves as a reference manual and as a user's guide for the COBOL Intrinsic Function Module Tests in the 1985 COBOL Compiler Validation System (CCVS). GRA

N93-21393# Grenoble-1 Univ. (France). Techniques de l'Informatique, des Mathematiques, de la Microelectronique et de la Microscopie.
GEOMETRIC APPROACHES OF IMAGE GENERATION USING VORONOI MODELS Ph.D. Thesis [APPROCHES GEOMETRIQUES PAR MODELES DE VORONOI EN SEGMENTATION D'IMAGES]
Mahmoud Melkemi 1992 162 p In FRENCH
(ETN-93-92690) Avail: CASI HC A08/MF A02

Geometrical models for solving the problem of image segmentation and the problem of event detection in multisource imaging are investigated. The geometrical structure used is a punctual Voronoi diagram. A region segmentation approach based on the use of Voronoi tessellation is presented. Three main steps describe this algorithm: initialization, split and merge steps. Such a tool is used to provide a solution for the problem of multisource image analysis. The second segmentation approach is based on a cooperative process between edges and regions. The proposed method consists of the generation of an initial partition for which edges are included on frontiers of Voronoi regions. Split and merge operations are included. The data structure used for the realization of this algorithm is the generalized Voronoi diagram. For its computation, a new method providing an approximation of this structure is developed. The algorithm is based on the use of a classical punctual Voronoi diagram associated to seeds generated on detected contours. ESA

N93-21451# Grenoble-1 Univ. (France). Lab. d'Informatique Fondamentale et d'Intelligence Artificielle.
SKETCHES AND COMPUTATION
Dominique Duval (Limoges Univ., France.) and Jean-Claude Raynaud Dec. 1991 71 p Sponsored in part by CNRS
(RR-871-I-IMAG-123-LIFIA; ETN-93-92720) Avail: CASI HC A04/MF A01

A categorical framework based on sketches for specification and evaluation (in the sense of algebraic specifications and algebraic programming) is defined. Results and illustrative examples are given. This framework goes beyond the first motivation to specify computation in algebraic number fields. Sketches are redefined in order to deal explicitly with programs. Properties of expressions and terms, and also quasi algebraic sketches are introduced. Static evaluation in these sketches are described. This allows a rigorous basis for evaluation in structures (not necessarily equational) which admit an initial model to be proposed. For structures which do not have initial models, dynamic evaluation explains and justifies a more general process. At present, this process is not used in algebraic specification systems, but computer algebra systems are beginning to use it as a basic tool. Some applications of dynamic evaluation to computation in extension fields are given. ESA

N93-21472*# Environmental Research Inst. of Michigan, Ann Arbor. Space Automation and Robotics Center.
ROMPS CRITICAL DESIGN REVIEW DATA PACKAGE
M. E. Dobbs Dec. 1992 70 p
(Grant NAG5-1517)
(NASA-CR-191612; NAS 1.26:191612; Rept-238800-12-X) Avail: CASI HC A04/MF A01

The design elements of the Robot-Operated Material Processing in Space (ROMPS) system are described in outline and graphical form. The following subsystems/topics are addressed: servo system, testbed and simulation results, System V Controller, robot module, furnace module, SCL experiment supervisor and script sample processing control, battery system, watchdog timers, mechanical/thermal considerations, and fault conditions and recovery. CASI

N93-21549# Sandia National Labs., Albuquerque, NM.
TRANSIENT DYNAMICS CAPABILITY AT SANDIA NATIONAL LABORATORIES
S. W. Attaway, J. H. Biffle, G. D. Sjaardema, M. W. Heinstein, and L. A. Schoof 1992 44 p Presented at the Workshop on Computational Methods for Crashworthiness, Hampton, VA, 2-3 Sep. 1992
(Contract DE-AC04-76DP-00789)
(DE93-002285; SAND-92-2151C; CONF-9209260-1) Avail: CASI HC A03/MF A01

This report will present a brief overview of the transient dynamics capabilities at Sandia National Laboratories, with an emphasis on recent new developments and current research. In addition, the Sandia National Laboratories (SNL) Engineering Analysis Code Access System (SEACAS), which is a collection of structural and thermal codes and utilities used by analysts at SNL, will be described. The SEACAS system includes pre- and post-processing codes, analysis codes, database translation codes, support libraries, Unix shell scripts for execution, and an installation system. SEACAS is used at SNL on a daily basis as a production, research, and development system for the engineering analysts and code developers. Over the past year, approximately 190 days of CPU time have been used by SEACAS codes on jobs running from a few seconds up to two and one-half days of CPU time. SEACAS is running on several different systems at SNL including Cray Unicos, Hewlett Packard HP-UX, Digital Equipment Ultrix, and Sun SunOS. An overview of SEACAS, including a short description of the codes in the system, will be presented. Abstracts and references for the codes are listed at the end of the report. DOE

N93-21563*# Research Inst. for Computing and Information Systems, Houston, TX.
FUZZY SET METHODS FOR OBJECT RECOGNITION IN SPACE APPLICATIONS Quarterly Interim Report No. 2, 1 Oct. - 31 Dec. 1991
James M. Keller (Missouri Univ., Columbia.) 31 Dec. 1991 72 p
(Contract NCC9-16; RICIS Proj. SE-42)
(NASA-CR-191986; NAS 1.26:191986) Avail: CASI HC A04/MF A01

During the reporting period, the development of the theory and application of methodologies for decision making under uncertainty was addressed. Two subreports are included; the first on properties of general hybrid operators, while the second considers some new research on generalized threshold logic units. In the first part, the properties of the additive gamma-model, where the intersection part is first considered to be the product of the input values and the union part is obtained by an extension of De Morgan's law to fuzzy sets, is explored. Then the Yager's class of union and intersection is used in the additive gamma-model. The inputs are weighted to some power that represents their importance and thus their contribution to the compensation process. In the second part, the extension of binary logic synthesis methods to multiple valued logic synthesis methods to enable the synthesis of decision networks when the input/output variables are not binary is discussed. Derived from text

N93-21647*# North Carolina State Univ., Raleigh. Dept. of Computer Science.
MULTIVERSION SOFTWARE RELIABILITY THROUGH FAULT-AVOIDANCE AND FAULT-TOLERANCE Semiannual Technical Report No. 2, 1 Sep. 1989 - 31 Mar. 1990
Mladen A. Vouk and David F. McAllister 31 Mar. 1990 48 p
(Grant NAG1-983)
(NASA-CR-192191; NAS 1.26:192191) Avail: CASI HC A03/MF A01

In this project we have proposed to investigate a number of experimental and theoretical issues associated with the practical use of multi-version software in providing dependable software through fault-avoidance and fault-elimination, as well as run-time tolerance of software faults. In the period reported here we have working on the following: We have continued collection of data on the relationships between software faults and reliability, and the coverage provided by the testing process as measured by different metrics (including data flow metrics). We continued work on software reliability estimation methods based on non-random sampling, and the relationship between software reliability and code coverage provided through testing. We have continued studying back-to-back testing as an efficient mechanism for removal of uncorrelated faults, and common-cause faults of variable span. We have also been studying back-to-back testing as a tool for improvement of the software change process, including regression testing. We continued investigating existing, and worked on formulation of new fault-tolerance models. In particular, we have partly finished evaluation of Consensus Voting in the presence of correlated failures, and are in the process of finishing evaluation of Consensus Recovery Block (CRB) under failure correlation. We find both approaches far superior to commonly employed fixed agreement number voting (usually majority voting). We have also finished a cost analysis of the CRB approach. Derived from text

N93-21661*# Research Inst. for Computing and Information Systems, Houston, TX.
EXPERT SYSTEM VERIFICATION AND VALIDATION STUDY: WORKSHOP AND PRESENTATION MATERIAL
Scott W. French (International Business Machines Corp., Houston, TX.)

and David Hamilton (International Business Machines Corp., Houston, TX.) Aug. 1992 534 p
(Contract NCC9-16; RICIS Proj. AL-16)
(NASA-CR-192176; NAS 1.26:192176) Avail: CASI HC A23/MF A04

Workshop and presentation material are included. Following an introduction, the basic concepts, techniques, and guidelines are discussed. Handouts and worksheets are included. CASI

N93-21687# National Inst. of Standards and Technology, Gaithersburg, MD. Computer Systems Lab.
HIGH INTEGRITY SOFTWARE STANDARDS AND GUIDELINES
Delores R. Wallace, Laura M. Ippolito, and D. Richard Kuhn Sep. 1992 107 p Sponsored by Nuclear Regulatory Commission
(Contract NRC-RES-91-003)
(PB93-114619; NIST/SP-500/204) Avail: CASI HC A06/MF A02

The report presents results of a study of standards, draft standards, and guidelines (all of which will hereafter be referred to as documents) that provide requirements for the assurance of software in safety systems in nuclear power plants. The study focused on identifying the attributes necessary in a standard for providing reasonable assurance for software in nuclear systems. The study addressed some issues involved in demonstrating conformance to a standard. The documents vary widely in their requirements and the precision with which the requirements are expressed. Recommendations are provided for guidance for the assurance of high integrity software. It is recommended that a nuclear industry standard be developed based on the documents reviewed in this study with additional attention to the concerns identified in this report. GRA

N93-21735# Los Alamos National Lab., NM.
COMPUTATIONAL MECHANICS AT LOS ALAMOS NATIONAL LABORATORY
C. A. Anderson 1992 11 p Presented at the Winter Annual Meeting of the ASME, Anaheim, CA, 8-13 Nov. 1992
(Contract W-7405-eng-36)
(DE93-003725; LA-UR-92-3410; CONF-921110-34) Avail: CASI HC A03/MF A01

Supercomputers can be used to solve structural problems characterized by complex material behavior and geometry. This paper presents two examples of supercomputer applications in structural mechanics that are industry driven -- numerical analysis of the process of radial keratotomy of the human eye and an analysis of the fracture of a pump block. DOE

N93-21820# Bombardier, Inc., Montreal (Quebec). Canadair Div.
FURTHER DEVELOPMENT OF THE CANAERO COMPUTER CODE TO INCLUDE A TIME-STEPPING CAPABILITY Final Report
J. Conway and F. Tezok Oct. 1991 127 p
(DREA-CR-91-478; CTN-93-60715; RAZ-000-563) Avail: CASI HC A07

The CANAERO panel method has been successfully extended to perform unsteady incompressible inviscid calculations using a time-stepping procedure with wake convection. The new program, called CANAERO-T, provides an unsteady potential flow panel method for calculating the flow around, and forces and moments on, complex configurations. CANAERO-T has been interfaced with the OMNIPLOT graphics package to permit animated displays of geometry and aerodynamics. The implementation and testing of the new CANAERO-T unsteady code are described, together with a description of the mathematical formulation of the method, some features of which appear to be unique to CANAERO-T. Results from CANAERO-T are presented for the following test cases: an impulsively started wing; an impulsively started oscillating wing; two impulsively started wings with one located in the slipstream of the other; a 3-bladed marine propeller; an impulsively started submarine at 9 degrees of drift; and a maneuvering submarine. The results have shown that unsteady effects are crucial in calculating the forces and moments on a hull plus sail configuration during a turn maneuver. Author (CISTI)

N93-21845# Fermi National Accelerator Lab., Batavia, IL.
INTEGRATED FASTBUS, VME AND CAMAC DIAGNOSTIC SOFTWARE AT FERMILAB
J. Anderson, R. Forster, J. Franzen, and N. Wilcer Oct. 1992 6 p Presented at the IEEE Meeting, Orlando, FL, 26-30 Oct. 1992
(Contract DE-AC02-76CH-03000)
(DE93-004424; FNAL/C-92/300; CONF-9210232-4) Avail: CASI HC A02/MF A01

A fully integrated system for the diagnosis and repair of data acquisition hardware in FASTBUS, VME, and CAMAC is described. A short cost/benefit analysis of using a distributed network of personal computers for diagnosis is presented. The SPUDS (Single Platform Uniting Diagnostic Software) software package developed at Fermilab is introduced. Examples of how SPUDS is currently used in the Fermilab equipment repair facility, as an evaluation tool and for field diagnostics, are given. DOE

N93-21855# Fermi National Accelerator Lab., Batavia, IL.
EXPERIENCES WITH THE ACPMAPS 50 GFLOP SYSTEM
M. Fischler Oct. 1992 5 p Presented at the Tenth Conference on Computing in High Energy Physics, Annecy, France, 21-25 Sep. 1992
(Contract DE-AC02-76CH-03000)
(DE93-004418; FNAL/C-92/277; CONF-920966-15) Avail: CASI HC A01/MF A01

The Fermilab Computer R&D and Theory departments have for several years collaborated on a multi-GFLOP (recently upgraded to 50 GFLOP) system for lattice gauge calculations. The primary emphasis is on flexibility and ease of algorithm development. This system (ACPMAPS) has been in use for some time, allowing theorists to produce QCD results with relevance for the analysis of experimental data. We present general observations about benefits of such a scientist-oriented system and summarize some of the advances recently made. We also discuss what was discovered about features needed in a useful algorithm exploration platform. These lessons can be applied to the design and evaluation of future massively parallel systems (commercial or otherwise). DOE

N93-21964# Northwestern Univ., Evanston, IL. Dept. of Mechanical Engineering.
VARIATIONAL NODAL SOLUTION ALGORITHMS FOR MULTIGROUP CRITICALITY PROBLEMS
C. B. Carrico and E. E. Lewis 1991 5 p Presented at the International Topical Meeting on Advances in Mathematics, Computation and Reactor Physics, Pittsburgh, PA, 28 Apr. - 2 May 1991
(Contracts DE-FG02-88ER-12810; W-31-109-eng-38)
(DE93-003462; CONF-910414-38) Avail: CASI HC A01/MF A01

Variational nodal transport methods are generalized for the treatment of multigroup criticality problems. The generation of variational response matrices is streamlined and automated through the use of symbolic manipulation. A new red-black partitioned matrix algorithm for the solution of the within-group equations is formulated and shown to be at once both a regular matrix splitting and a synthetic acceleration method. The methods are implemented in X-Y geometry as a module of the Argonne National Laboratory code DIF3D. For few group problems highly accurate P(sub 3) eigenvalues are obtained with computing times comparable to those of an existing interface-current nodal transport method. DOE

N93-22004*# Maryland Univ., College Park. Advanced Visualization Lab.
DEVELOPMENT OF VISUAL PROGRAMMING TECHNIQUES TO INTEGRATE THEORETICAL MODELING INTO THE SCIENTIFIC PLANNING AND INSTRUMENT OPERATIONS ENVIRONMENT OF ISTP Final Report
Charles C. Goodrich 26 Mar. 1993 16 p Original contains color illustrations
(Grant NAG5-1825)
(NASA-CR-192707; NAS 1.26:192707) Avail: CASI HC A03/MF A01; 3 functional color pages

The goal of this project is to investigate the use of visualization software based on the visual programming and data-flow paradigms to meet the needs of the SPOF and through it the International Solar Terrestrial Physics (ISTP) science community. Specific needs we address include science planning, data interpretation, comparisons of data with simulation and model results, and data acquisition. Our accomplishments during the twelve month grant period are discussed below. Author (revised)

N93-20658# British Columbia Univ., Vancouver. Dept. of Mechanical Engineering.
ANALYSIS OF STRUCTURALLY-VARYING SYSTEMS USING COMPONENT-MODE SYNTHESIS TECHNIQUE

Jie Peng and Clarence W. deSilva *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 246-247 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20688# Manitoba Univ., Winnipeg. Dept. of Mechanical Engineering.
ON THE EVALUATION OF COHERENT STRUCTURES USING COMPUTER PROGRAMS
A. E. Tanjo and R. S. Azad *In its* Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 490-491 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20722# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
THE NEXT REVOLUTION IN COMPUTER-AIDED ENGINEERING
F. A. Salustri and R. D. Venter *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 680-681 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20723# Manitoba Univ., Winnipeg. Dept. of Mechanical and Industrial Engineering.
TC CURVES AND TS SURFACES AND THEIR APPLICATIONS IN CAD/CAM
Yisui Jiang and Ray P. S. Han *In its* Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 700-701 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-21424*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
INTELLIGENT SYSTEMS TECHNOLOGY INFRASTRUCTURE FOR INTEGRATED SYSTEMS Abstract Only
Henry Lum *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 17 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21425*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
RESULTS OF PROTOTYPE SOFTWARE DEVELOPMENT FOR AUTOMATION OF SHUTTLE PROXIMITY OPERATIONS Abstract Only
Hal Hiers and Oscar Olszweski (Lockheed Engineering and Sciences Co., Houston, TX.) *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 17 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

N93-21938# Science Applications International Corp., Santa Clara, CA.
COMPUTER SIMULATIONS AND PERFORMANCE PREDICTIONS FOR EXPLOSIVE DETECTION SYSTEMS
Joseph Bendahan, E. Elias, Z. Shayer, J. Pierre, E. Altschuler, and Tsahi Gozani *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 840-849 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

N93-21939# North Carolina Agricultural and Technical State Univ., Greensboro. Dept. of Electrical Engineering.
RECOGNITION OF PARTIALLY OCCLUDED THREAT OBJECTS BASED ON HYBRID HOPFIELD NEURAL NETWORK
Jung Hyoun Kim, E. H. Park, C. Ntuen, and Shiu M. Cheung (Federal Aviation Administration, Atlantic City, NJ.) *In* FAA, Proceedings of the First International Symposium on Explosive Detection Technology May 1992 p 850-859 (For primary document see N93-21856 07-03)
Avail: CASI HC A02/MF A10

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N93-20240# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
A COUPLED MULTI-ALU PROCESSING NODE FOR A HIGHLY PARALLEL COMPUTER
Stephen W. Keckler Sep. 1992 166 p
(Contracts N00014-88-K-0738; N00014-87-K-0825; F19628-92-C-0045; NSF MIP-86-57531)
(AD-A259455; AI-TR-1355) Avail: CASI HC A08/MF A02

By 1995, improvements in semiconductor technology will allow as many as four high-performance floating-point arithmetic and logic units (ALU's) and several megabits of memory to reside on a single chip. Multiple arithmetic units can be organized into a single processor to exploit instruction-level parallelism. Processor Coupling is a mechanism for controlling multiple ALU's to exploit both instruction-level and inter-thread parallelism. Processor Coupling employs both compile time and runtime scheduling. The compiler statically schedules individual threads to discover available intra-thread instruction-level parallelism. The runtime scheduling mechanism interleaves threads, exploiting inter-thread parallelism to maintain high ALU utilization. ALU's are assigned to threads on a cycle by cycle basis, and several threads can be active concurrently. GRA

N93-20789# Grenoble-1 Univ. (France). Lab. de Modelisation et Calcul.
OPTIMAL BROADCASTING ALGORITHMS ON TORUS
Philippe Michallon, Denis Trystram, and Gilles Villard Jan. 1992 48 p Sponsored by CNRS
(RR-872-I; ETN-93-92715) Avail: CASI HC A03/MF A01

Arc-disjoint spanning trees for torus are presented. This basic tool is useful for broadcasting a message from one processor to all the others: the strategy consists of pipelining parts of the initial message along the spanning trees. Assuming a store and forward full duplex model of communications, the construction of 4-arc-disjoint spanning trees of nominal depth which improves the previous results by providing an optimal result for broadcasts based on pipelining is presented. These theoretical studies are completed by some experiments on a 128 reconfigurable transputer network. The architecture is presented and its communication model is analyzed. Broadcasting algorithms are developed and some experimental results are given. ESA

N93-20798# Grenoble-1 Univ. (France). Lab. de Genie Informatique.
EVALUATION AND COMPARATIVE STUDY OF COMBINATORIAL OPTIMIZATION ALGORITHMS: APPLICATION TO THE PROBLEM OF PROCESS PLACEMENT
E.-G. Talbi and T. Muntean Apr. 1992 38 p In FRENCH; ENGLISH summary Sponsored by EEC
(RR-886-I; ETN-93-92717) Avail: CASI HC A03/MF A01

An example application of local search iterative algorithms, simulated annealing, and genetic algorithms, is presented: the problem of static placement of communication processes on a distributed memory parallel architecture. Classical graph partitioning and quadratic assignment problems are examples of the problem addressed. Each algorithm studied is evaluated and optimized in relation to its parameters. The parallelization of the algorithms is studied; a genetic algorithm is proposed, and implemented on a transputer network. Performances are compared according to the quality of the solution found and the search time used. A combination of the algorithms is proposed and evaluated. ESA

N93-20866# Institut National de Recherche d'Informatique et d'Automatique, Le Chesnay (France). Programme 4: Robotique, Image et Vision.
LOCAL EDGE GROUPING BY SIMPLE PROCESS ITERATION
Frank Mangin, Marc Berthod, and Josiane Zerubia Nov. 1991 24 p
(INRIA-RR-1559; ETN-93-92668) Avail: CASI HC A03/MF A01

An iterative algorithm for edge intensity images enhancement is proposed. It uses local cooperation-inhibition processes to produce an edge image in which the most relevant contours have reached maximal activation, and small gaps and junctions have been filled. Implementation on a massively parallel machine provided high speed performances, and results of

experimentations with images of real scenes are presented. The algorithm is robust in complex edge images context, and is perfectly stable under any number of iterations. ESA

N93-20886# Grenoble-1 Univ. (France). Lab. de Genie Informatique.
A CONTRIBUTION TO THE STUDY OF OR-PARALLEL IN PROLOG OVER DISTRIBUTED MEMORY MACHINES Ph.D. Thesis [UNE CONTRIBUTION A L'ETUDE DU PARALLELISME OU EN PROLOG SUR DES MACHINES SANS MEMOIRE COMMUNE]
Claudio Fernando ResinGeyer 1991 158 p In FRENCH
(ETN-93-92681) Avail: CASI HC A08/MF A02

The implementation of OR-parallel PROLOG over distributed memory machines is studied. The OPERA OR multi-sequential model is presented. It uses compiling techniques and preserves the PROLOG semantics. Multi-environment management and scheduling, the two major problems of OPERA, are described. Multi-environment management is realized by incremental copying, in parallel to the computation. The treatment of conditional variables is included in the Warren Abstract Machine (WAM), in order to allow an efficient and coherent cooperation. The method introduces a new pile for these variables, initialization, binding and unbinding of which are adapted. The cost of WAM sequential operations is constant and independent of the number of processes. A method for implementing cut in parallel is proposed. An OPERA prototype was implemented over a transputer array. In the current prototype, scheduling is resolved by heuristics of load evaluation. This scheduling is centralized, a unique process balancing the load of the other PROLOG workers, and using an approximate representation of the state of the system. The OPERA prototype is one of the most efficient PROLOG implementations on the transputer, and reaches effective speedups in parallel. ESA

N93-20894# Institut National de Recherche d'Informatique et d'Automatique, Le Chesnay (France). Programme 1: Architectures Paralleles, Bases de Donnees, Reseaux et Systemes Distribues.
ANALYSIS OF TIMED-TOKEN RING PROTOCOLS
Eitan Altman Dec. 1991 25 p
(INRIA-RR-1570; ETN-93-92671) Avail: CASI HC A03/MF A01

The performance of Token Ring Protocols with constraints on the cycle times is analyzed. Each station may have a different cycle time constraint, and a different number of buffers. Two types of service discipline are considered in the different stations: the 1 limited case, where at most one packet may be transmitted from each queue at each visit of the token, and the exhaustive service discipline where in each queue, packets are trasmitted till either the queue empties or the cycle time constraint in that queue is exceeded. The system analyzed approximates both the FDDI protocol (Fiber Distributed Data Interface) and the IEEE 802.4 Token Bus Standard. The technique of the analysis is based on the power series expansions of the state probabilities as functions of the load of the system, a method for analyzing multi dimensional queuing systems. The expected throughput and delay in every station are obtained as well as the first two moments of the queues' length. ESA

N93-20949# Grenoble-1 Univ. (France). Lab. de Modelisation et Calcul.
PAC: PARALLEL ALGEBRAIC COMPUTATIONS: CURRENT RESEARCHES AND PERSPECTIVES
J. L. Roch and G. Villard Jan. 1992 35 p Partly in ENGLISH and FRENCH Sponsored in part by CNRS
(RR-876-M; ETN-93-92705) Avail: CASI HC A03/MF A01

A general presentation of the PAC (Parallel Algebraic Computing) project is given. PAC is an environment dedicated to algebraic computations and is designed for distributed memory parallel architectures. The past and current researchers of the project are discussed and its perspectives are detailed. Efforts are mainly concentrated on the study of real life dimensioned applications, and on the implementation and the validation of a dynamic load balancing system. The different problems encountered while parallelizing an application are illustrated. From the sequential algorithm to the implementation in an existing parallel machine, the difficulties are presented, and solutions are proposed. The example which is treated is the parallel lattice basis reduction. A complexity result is given, and the theoretical study is completed by empirical tests which show that high speed ups are obtained even for large amounts of processors. A crucial problem of computer algebra is addressed. One main constraint of the domain and more generally of non numerical computations, is the dynamical, nonpredictible, behavior of the executions. A new load balancing system for parallel architectures with a great number of processors is proposed. It is original in the sense that it considers the task complexity as a consistent information in order to achieve efficiency. The load balancer is currently under development and will be validated with linear algebra computations on polynomials and lattice basis reduction. ESA

N93-21000# Ecole Centrale de Lyon (France).
STUDY AND DEVELOPMENT OF A MULTIPROCESSOR INTERFACE CIRCUIT, VOLUME 1 Ph.D. Thesis [ETUDE ET REALISATION D'UN CIRCUIT D'INTERFACE DANS UN ENVIRONNEMENT MULTIPROCESSEUR]
Jean-Michel Courbet 1991 195 p In FRENCH
(ECL-91-11-Vol-1; ETN-93-91950) Avail: CASI HC A09/MF A03

A PSB (Parallel System Bus) for the Multibus 2 system is described. The evolution of specific and standard buses available on the market is analyzed and characteristics of the developed PSB are described. The interface circuit was developed to be well fitted to transfers in I/O (Input/Output) space with the aim of a standard interface, and to report treatments on I/O data in a CPU (Central Processing Unit) board connected to the bus. The first version is a SMD module with a gate array which contains the major parts of the interface logic. This is a CMOS component integrating 2500 gates in a 2 micrometer technology; to achieve its development internal (Intel) tools were used rather than more classical methods (which are more expensive): for instance, the interface is functionally tested using a specific testing printed board and a testing software. A second wholly integrated version of the interface was realized the same way, using a 4800 gates CMOS gate array with a 1.5 micrometer technology. ESA

N93-21043*# Boeing Aerospace Co., Seattle, WA. Military Airplanes Div.
FORMAL VERIFICATION OF A MICROCODED VIPER MICROPROCESSOR USING HOL
Karl Levitt (California Univ., Davis.), Tejkumar Arora (California Univ., Davis.), Tony Leung (California Univ., Davis.), Sara Kalvala (California Univ., Davis.), E. Thomas Schubert (California Univ., Davis.), Philip Windley (California Univ., Davis.), Mark Heckman (California Univ., Davis.), and Gerald C. Cohen Washington Feb. 1993 300 p
(Contract NAS1-18586; RTOP 505-64-10-07)
(NASA-CR-4489; NAS 1.26:4489) Avail: CASI HC A13/MF A03

The Royal Signals and Radar Establishment (RSRE) and members of the Hardware Verification Group at Cambridge University conducted a joint effort to prove the correspondence between the electronic block model and the top level specification of Viper. Unfortunately, the proof became too complex and unmanageable within the given time and funding constraints, and is thus incomplete as of the date of this report. This report describes an independent attempt to use the HOL (Cambridge Higher Order Logic) mechanical verifier to verify Viper. Deriving from recent results in hardware verification research at UC Davis, the approach has been to redesign the electronic block model to make it microcoded and to structure the proof in a series of decreasingly abstract interpreter levels, the lowest being the electronic block level. The highest level is the RSRE Viper instruction set. Owing to the new approach and some results on the proof of generic interpreters as applied to simple microprocessors, this attempt required an effort approximately an order of magnitude less than the previous one.
Author (revised)

N93-21064# Grenoble-1 Univ. (France). Lab. de Genie Informatique.
VERIFICATION METHODS OF THE BEHAVIORAL SPECIFICATIONS: STUDY AND IMPLEMENTATION Ph.D. Thesis [METHODES DE VERIFICATION DE SPECIFICATIONS COMPORTEMENTALES: ETUDE ET MISE EN OEUVRE]
Laurent Mounier 1992 205 p In FRENCH
(ETN-93-92687) Avail: CASI HC A10/MF A03

The verification of the behavioral specifications for parallel programs is presented. The design of efficient algorithms for the comparison of two labeled transition systems modulo a simulation or bisimulation relation is included. The principle of the classical decision procedures based on partition refinement algorithms is reviewed. This approach requires previous building of the transition relations of the two systems before the comparison phase which constitutes a practical limitation. An algorithm based on a depth first

traversal of a synchronous product of the two systems is proposed. It can perform the comparison 'on the fly', without explicitly building or storing the two transition relations. This 'on the fly' comparison algorithm was implemented within the Aldebaran verification tool. Its application to the verification of several LOTOS programs confirms the interest of this approach in comparison with the more classical one. Diagnostic generation when the two labeled transitions systems are not equivalent is discussed. ESA

N93-21065# Grenoble-1 Univ. (France). Techniques de l'Informatique, des Mathematiques, de la Microelectronique et de la Microscopie.
MODELING AND SIMULATION OF A FORMAL NEURAL NETWORK: IMPLEMENTATION ON A 'HYPERCUBE FPS T-40' PARALLEL MACHINE Ph.D. Thesis [MODELISATION ET SIMULATION D'UN RESEAU DE NEURONES FORMELS: IMPLANTATION SUR MACHINE PARALLELE 'HYPERCUBE FPS T-40']
Djamel Benaouda 1992 252 p In FRENCH Original contains color illustrations
(ETN-93-92688) Avail: CASI HC A12/MF A03

A study to model the neural networks located downstream of the cochlear nucleus which constitutes the first layer of speech signals processing coming from the perripheral auditory system, particularly from the basilar membrane, is presented. These signals represent the neuronal information carried by the auditory nerve fibers. The activitiy of these fibers is described through the recording of spike strains that constitutes the input to be treated by the network. The input is modeled by a two dimensional binary random field. The nature of the temporal, spatial, and stochastic neural signal is taken into account. The general frame of the neural network is presented. Models based on the threshold automata networks and cellular automata networks are included. The Gibbs measure, random fields, and network models are presented. The study on the ergodicity problem of the probabilistic neural networks is considered. In the simple cases, the model of the neural network in parallel iteration mode is ergodic and converges to the unique invariant measure mu(sub p), in response to the stationary input. The technical environment where the simulations of the neural network were realized is described. A general survey of the parallelization principles and an introduction to the parallel distributed memory machine 'Hypercube FPS (Floating Point System) T-40' is presented. The implementation of the neural network algorithm on the Hypercube FPS T-40, the numerical experimentations, and the interpretation of the numerical results are discussed. The results are visualized graphically on an image processing workstation (VINIX) using the appropriate statistical measures which summarize the dynamic behavior of the neural network. ESA

N93-21721# Sandia National Labs., Albuquerque, NM.
DELIVERY OF VERY HIGH BANDWIDTH WITH ATM SWITCHES AND SONET
S. A. Gossage Oct. 1992 37 p
(Contract DE-AC04-76DP-00789)
(DE93-004274; SAND-92-1295) Avail: CASI HC A03/MF A01

The choice of technologies for the delivery of very high bandwidth throughout a facility capable of ultimately achieving gigabits per second performance, is a crucial one for any high technology facility. The components of a high bandwidth delivery system include high performance sources and sinks in the form of central facilities (major mainframes, large file storage and specialized peripherals) and powerful, full bandwidth distributed local area networks (LAN's). In order to deliver bandwidth among the sources and sinks, a ubiquitous inter-/intra-building cable plant consisting of single mode and multimode fiber as well as twisted pair copper is required. The selection of the 'glue' to transport and interconnect the LAN's with the central facility over the pervasive cable plant is the focus of this paper. A design philosophy for high performance communications systems is proposed. A description of the traditional problems that must be overcome to provide very high bandwidth beyond the narrow confines of a computer center is given. The advantages of ATM switching and SONET physical transport are explored in the structured design presentation. The applicability of Asynchronous Transfer Mode (ATM) switching (interconnection) and Synchronous Optical NETwork (SONET) (transport) for high bandwidth delivery is described using the environment and requirements of Sandia National Laboratories as a context to examine the suitability of those technologies. The synergy and utility of ATM and SONET in the campus network are explored. Other methods for distributing high data rates are compared and contrasted to ATM and SONET with respect to cable plant impact, reliability/availability, maintainability, and capacity. Sandia is implementing a standards based foundation utilizing a pervasive single mode fiber cable plant, SONET transport, and ATM switching to meet the goals of gigabit networking. DOE

N93-21741# Argonne National Lab., IL.
SOLUTION OF LARGE, SPARSE SYSTEMS OF LINEAR EQUATIONS IN MASSIVELY PARALLEL APPLICATIONS
M. T. Jones and P. E. Plassmann 1992 10 p Presented at the ACM/IEEE Supercomputing Conference, Minneapolis, MN, 14-21 Nov. 1992
(Contract W-31-109-eng-38)
(DE93-004243; ANL/CP-77516; CONF-921125-5) Avail: CASI HC A02/MF A01

We present a general-purpose parallel iterative solver for large, sparse systems of linear equations. This solver is used in two applications, a piezoelectric crystal vibration problem and a superconductor model, that could be solved only on the largest available massively parallel machine. Results obtained on the Intel DELTA show computational rates of up to 3.25 gigaflops for these applications. DOE

N93-21852# Los Alamos National Lab., NM.
RESEARCH IN MODELS FOR MASSIVELY PARALLEL COMPUTING
N. R. Morse 21 Oct. 1992 4 p Presented at the IEEE Scientific Supercomputing Subcommittee Meeting, Livermore, CA, 25 Oct. 1992
(Contract W-7405-eng-36)
(DE93-003748; LA-UR-92-3495; CONF-9210229-1) Avail: CASI HC A01/MF A01

Supercomputing in the DoE has been traditionally performed on von Neumann vector pipeline machines. In the past few years, a belief has developed that advances in supercomputing capability in the future must come from massively parallel architectures. When considering such architectures, many questions remain which are active areas of research. Examples of research subjects for massively parallel computing paradigms are communication structures, memory structures, node processor architectures, latency hiding, algorithm development, switching schemes, communication bandwidth and support software. A problem which has existed in computing since networks were invented is that the quality of service received by those using a computing resource is inversely proportional to the user's physical distance from the server. The goal of the CASA Gigabit project is to remove this restriction by inventing gigabit speed networks with support protocols, switches, etc. which will operate at global distances. DOE

N93-20659# Colorado School of Mines, Golden. Dept. of Engineering.
INSTABILITY AND VARIATION ANALYSIS USING A PARALLEL SUBSTRUCTURING PROCEDURE
H. P. Huttelmaier *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 248-249 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N93-19997# Honeywell, Inc., Minneapolis, MN. Sensor and System Development Center.
PROBABILISTIC STUDENT MODELING WITH KNOWLEDGE SPACE THEORY Interim Report, Feb. 1991 - Feb. 1992
Michael Villano and Charles Bloom Oct. 1992 16 p
(Contract F33615-91-C-0002)
(AD-A258622; AL-TP-1992-0046) Avail: CASI HC A03/MF A01

This article presents Knowledge Space Theory (Falmagne and Doignon) as the foundation for a probabilistic student model to be imbedded in an intelligent Tutoring System (ITS). Applications to typical ITS student modeling issues such as knowledge representation, adaptive assessment, curriculum

representation, advancement criteria, and student feedback are discussed. Several factors contribute to uncertainty in student modeling such as careless errors and lucky guesses, learning and forgetting, and unanticipated student response patterns. However, a probabilistic student model can represent uncertainty regarding the estimate of the student's knowledge and can be tested using empirical student data and established statistical techniques. GRA

N93-20012# SRI International Corp., Menlo Park, CA.
UPSIDE-DOWN META-INTERPRETATION OF THE MODEL ELIMINATION THEOREM-PROVING PROCEDURE FOR DEDUCTION AND ABDUCTION
Mark E. Stickel 14 Sep. 1992 20 p
(Contract N00014-90-C-0220; NSF CCR-89-22330)
(AD-A259436) Avail: CASI HC A03/MF A01

Typical bottom-up, forward-chaining reasoning systems such as hyperresolution lack goal-directedness while typical top-down, backward-chaining reasoning systems like Prolog or model elimination repeatedly solve the same goals. Reasoning systems that are goal-directed and avoid repeatedly solving the same goals can be constructed by formulating the top-down methods metatheoretically for execution by a bottom-up reasoning system (hence, upside-down meta-interpretation is being used). This also facilitates the use of flexible search strategies, such as merit-ordered search, that are common to bottom-up interpreters. The model elimination theorem proving procedure, its extension by an assumption rule for abduction and its restriction to Horn clauses, are adapted here for such upside-down meta-interpretation. This model can be regarded as an extension of the magic set method for query evaluation in deductive databases to both non-Horn clauses and abductive reasoning. GRA

N93-20239# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
GEOMETRIC ASPECTS OF VISUAL OBJECT RECOGNITION
Thomas M. Breuel May 1992 174 p
(Contracts N00014-89-J-3139; N00014-85-K-0124; DACA76-85-C-0010)
(AD-A259454; AI-TR-1374) Avail: CASI HC A08/MF A02

Systems (artificial or natural) for visual object recognition are faced with three fundamental problems: the correspondence problem, the problem of representing 3D shape, and the problem of defining a robust similarity measure between images and views of objects. In this thesis, I address each of these problems. I present a recognition algorithm (RAST) that works efficiently even when no correspondence or grouping information is given; that is, it works in the presence of large amounts of clutter and with very primitive features. I discuss representations of 3D objects as collections of 2D views for the purposes of visual object recognition. Such representations greatly simplify the problems of model acquisition and representing complex shapes. I present theoretical and empirical evidence that this view-based approximation is an efficient, robust, and reliable approach to 3D visual object recognition. I present Bayesian and MDL approaches to the similarity problem that may help us build more robust recognition systems. GRA

N93-20241# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
ROBOT MOTION VISION BY FIXATION
M. A. Taalebinezhaad Sep. 1992 148 p
(Contracts N00014-85-K-0124; N00014-91-J-4038)
(AD-A259456; AI-TR-1384) Avail: CASI HC A07/MF A02

In numerous current and future applications ranging from autonomous navigation of mobile robots to collision avoidance systems for cars, an imaging system (installed on a moving vehicle) takes 2D images of an environment with the aim of finding the motion of the vehicle (translational and rotational velocities) as well as the structure of the environment (shape). In machine vision, this problem is referred to as the general motion vision problem. A direct method called fixation for solving this general motion vision problem, arbitrary motion relative to an arbitrary environment is introduced. Avoiding feature correspondence and optical flow was the motivation behind this direct method which uses the spatio-temporal brightness gradients of the images directly. The fixation method results in a linear constraint equation (Fixation Constraint Equation) which explicitly expresses the rotational velocity in terms of the translational velocity. The combination of this constraint equation with the Brightness-Change Constraint Equation (a fundamental equation which relates the motion to the brightness gradients at any image point) solves the general motion vision problem. GRA

N93-20308 Department of the Navy, Washington, DC.
SIGNAL PHASE PATTERN SENSITIVE NEURAL NETWORK SYSTEM AND METHOD Patent
Steven L. Speidel, inventor (to Navy) 8 Sep. 1992 33 p Filed 19 Jun. 1989
(AD-D015571; US-Patent-5,146,541; US-Patent-Appl-SN-368504) Avail: US Patent and Trademark Office

A signal phase pattern sensitive neural network system can discern persistent patterns of phase in a time varying or oscillatory signal. The system employs duplicate inputs from each of its sensors to the processing elements of a first layer of its neural network, with the exception that one input is phase shifted relative to the other. The system also employs a modification of a conventional Kohonen competitive learning rule which is applied by the processing and learning elements of a second layer of its neural network. GRA

N93-20552# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
COMPARISON OF ARTIFICIAL NEURAL NETWORKS WITH A CONVENTIONAL HEURISTIC TECHNIQUE FOR OPTIMIZATION PROBLEMS M.S. Thesis
Jeffrey S. Gruner Dec. 1992 87 p
(AD-A259207; AFIT/GSO/ENG/92D-01) Avail: CASI HC A05/MF A01

The utility of the Hopfield and Kohonen artificial neural networks to the traveling salesman optimization problem is investigated. A third, non-neural-network technique (the Christofides Algorithm - a competitive, bounded-solution operations research technique) is also investigated for comparison to the artificial neural network solutions. An eight and forty-two city distribution are chosen for comparison of the solutions. GRA

N93-20557# Case Western Reserve Univ., Cleveland, OH. Dept. of Computer Engineering and Science.
NEURAL NETWORKS FOR REAL-TIME SENSORY DATA PROCESSING AND SENSORIMOTOR CONTROL Performance Report, 1 Jan. 1990 - 29 Dec. 1992
Randall D. Beer 29 Dec. 1992 5 p
(Contract N00014-90-J-1545)
(AD-A259120) Avail: CASI HC A01/MF A01

Our experimental work has focused upon a precise description of the wind fields for individual type A thoracic interneurons and is beginning to describe the leg movements associated with individual leg motor neurons. In the first set of experiments, a graduate student supported on the ONR grant has moved from studies on paired GI responses to the wind responses of the thoracic interneurons that receive inputs from the GI's. Although the basic wind field properties for the entire population were described earlier, we do not have the precise wind fields for individual interneurons. This information is necessary for further development of the escape model and for future experiments that will utilize the computer model to determine the extent to which wind field properties are due to convergence of vGI inputs. GRA

N93-20590# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
A VHDL INTERPRETER FOR MODEL-BASED DIAGNOSES M.S. Thesis
David R. Griffin Dec. 1992 323 p
(AD-A259122; AFIT/GCE/ENG/92D-03) Avail: CASI HC A14/MF A03

Model-based reasoning permits diagnostic applications to be written without waiting for someone to become an 'expert' of the system. For model-based diagnostics, there must be a model to reason from. This thesis explores using a VHDL description of the system as that model. A system based around a VHDL interpreter was written specifically for a model-based diagnostic algorithm. Currently, the diagnostic system uses an algorithm by Dries. This algorithm was derived from Scarl's Full Consistency Algorithm. The system was designed to be modular so that different diagnostic techniques could be implemented. It is divided into three parts: a VHDL parser, a VHDL interpreter, and a set of routines to implement Dries' Diagnose algorithm. The system can find stuck-at faults on combinatorial digital circuits. GRA

N93-20871# Institut National de Recherche d'Informatique et d'Automatique, Le Chesnay (France). Programme 4: Robotique, Image et Vision.

A 3D WORLD MODEL BUILDER WITH A MOBILE ROBOT

Zhengyou Zhang and Olivier D. Faugeras Nov. 1991 43 p Submitted for publication Sponsored in part by EEC

(INRIA-RR-1546; ETN-93-92666) Avail: CASI HC A03/MF A01

A system to incrementally build a world model with a mobile robot in an unknown environment is described. The model is segment based. A trinocular stereo system is used to build a local map about the environment. A global map is obtained by integrating a sequence of stereo frames taken when the robot navigates in the environment. The emphasis is on the representation of the uncertainty of three dimensional (3D) segments from stereo and on the integration of segments from multiple views. The proposed representation is simple and very convenient to characterize the uncertainty of segments. A Kalman filter is used to merge line segments matched. An important characteristic of the integration strategy is that a segment observed by the stereo system corresponds only to one part of the segment in space, so the union of the different observations gives a better estimate on the segment in space. The integration of 35 stereo frames taken in the robot room was successful. ESA

N93-20876# Technische Univ., Berlin (Germany). Fachbereich Elektrotechnik.

A CONTRIBUTION TO THE ADAPTIVE CONTROL OF SERVO-DRIVES WITH DIRECT CURRENT MOTOR Ph.D. Thesis [EIN BEITRAG ZUR ADAPTIVEN REGELLUNG ON SERVOANTREIBEN MIT GLEICHSTROM-MOTOR]

Junmai Wang 1992 127 p In GERMAN

(ETN-93-92562) Avail: CASI HC A07/MF A02

The adaptive servosystem was built in a pilot plant and constructed according to the design of a Model Identification Adaptive System (MIAS). The adaptive system procedure is described. A digital model was developed for parameter identification and control design. A second order submodel was derived from the fourth order complete model. Hence a strong reduction of calculation costs for parameter identification. It is shown that the complete model can be regenerated from the submodel. A direct computation procedure was developed for control design. The results show that direct computation is eight times as fast as conventional computation. Test results show that a coordination of parameter identification and optimal control design allows a better servosystem efficiency. ESA

N93-20941# Institut National des Sciences Appliquees de Lyon, Villeurbanne (France). Lab. de Modelisation des Systemes et Reconnaissance des Formes.

BASIC AND EVOLUTIVE CONCEPTS OF PATTERN RECOGNITION: PLURIDISCIPLINE APPROACH. APPROXIMATION CONCEPT Ph.D. Thesis [ASPECTS FONDAMENTAUX ET EVOLUTIFS DE LA RECONNAISSANCE DE FORMES. APPROCHE PLURIDISCIPLINAIRE. NOTION D'APPROXIMATION]

Claire Leschi 1991 390 p In FRENCH

(ISAL-91-0098; ETN-93-92693) Avail: CASI HC A17/MF A04

The purpose of the work is to investigate the appearance of concepts of pattern recognition approaches. Different approaches developed for pattern recognition, involving statistical models, structure, syntax, knowledge based systems and automata networks, are analyzed. The study takes into account investigations carried out in the field of psychology and neurosciences. The topics of concern involving present artificial pattern recognition investigations are discussed. Special attention is given to the classification and similarity concepts. Several tools to compare different entities from local to global concepts are presented. The concept of appproximation associated to the pre-topological structure is proposed as a basis to a similitude model for automatic perceptions. ESA

N93-21186 Politecnico di Milano (Italy). Dipt. di Elettronica e Informazione.

A HIGH-SPEED AUTO-TUNING PID REGULATOR BASED ON PROGRAMMABLE LOGIC DEVICES

G. Bico, M. Brambilla, Alberto Leva, N. Scarabottolo, and R. Scattolini 1992 15 p Sponsored in part by Italian Ministry of University Research and Science and Technology

(Rept-92-042; ETN-93-93039) Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

The prototype of a fast autotuning proportional integral derivative (PID) regulator where the control algorithm is implemented by the use of logic cell array devices, so that the sampling rates higher than 20 kHz can be obtained is presented. The autotuning method is based on a preliminary use of relay feedback to bring the process output to a permanent oscillation. Experimental results obtained by employing the prototype for speed control of a DC motor are reported. ESA

N93-21204*# Rensselaer Polytechnic Inst., Troy, NY. Center for Intelligent Robotic Systems for Space Exploration.

CTOS COURSE

D. R. Lefebvre, L. Page, and J. R. Noseworthy Nov. 1992 139 p (Grant NAGw-1333)

(NASA-CR-191866; NAS 1.26:191866; RPI-CIRSSE-128) Avail: CASI HC A07/MF A02

The topics are presented in viewgraph form and include the following: a Center for Intelligent Robotic Systems for Space Exploration (CIRSSE) Testbed Operating System (CTOS) overview; CTOS tasks and applications; building and sending CTOS messages; message data management; X-window input/output; CTOS configuration; CTOS startup; advanced tools and services; motion control systems (MCS), vision services system (VSS), and Petri Net (PN) controllers; and exercises. CASI

N93-21243# Federal Electro-Optics, Inc., Memphis, TN.

MULTI-APERTURE VISION SYSTEM COUPLED TO NEURAL NETWORK PROCESSORS Progress Report

Keith Bromley 15 Dec. 1992 27 p

(Contract N00014-92-C-0167)

(AD-A259353) Avail: CASI HC A03/MF A01

As outlined in the original proposal, FEO intends to determine how effectively a neural network coupled to a multiple aperture vision system (MAVS) can be applied to the tracking task. Over the course of the contract FEO will perform seven (7) experimental simulations to evaluate the proposed tracking systems' performance. The October 15, 1992 report discussed the modeling of the first three (3) configurations. This report discusses the results of the implementation of these first three experiments on the Silicon Graphics IRIS Indigo workstation. Additionally, FEO has completed the optical modeling of experiments four through seven and completed the C++ coding of experiments four and five. FEO has enclosed a DAT tape containing executable code and source code for experiments 1 through 3. The programs can be loaded onto a Silicon Graphics workstation using the tar tape facility. A description of the operation of each program is provided. Once begun, operation of the executable programs is self-explanatory. GRA

N93-21246# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering and Computer Science.

ROBUST CONTROLLER DESIGN: A BOUNDED-INPUT-BOUNDED-OUTPUT WORST-CASE APPROACH Final Report, Aug. 1990 - Dec. 1991

Munther A. Dahleh Mar. 1992 99 p

(Contract F33615-90-C-3608)

(AD-A259367; WL-TR-92-3067) Avail: CASI HC A05/MF A02

The problem of designing controllers that minimize the peak-to-peak gain, or the 1-one optimal control problem, in the presence of structured uncertainty is discussed in this report. Four problems are discussed. First, controller design in the presence of structured-uncertainty with a general discussion of the synthesis of 1-one optimal controllers is presented. Next, the 1-one state feedback problem is discussed. Then, the advantages of nonlinear controllers in minimizing the 1-infinity induced norm are summarized. Finally, peak-to-peak performance for slowly time varying systems are considered. GRA

N93-21261# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

AUTOMATIC DESIGN OF A MAGLEV CONTROLLER IN STATE SPACE

Feng Zhao and Richard Thornton Dec. 1991 19 p

(Contract N00014-89-J-3202; NSF MIP-90-01651)

(AD-A259336; AI-M-1303) Avail: CASI HC A03/MF A01

We describe the automatic synthesis of a global nonlinear controller for

stabilizing a magnetic levitation system that is a simplified model of the German Transrapid system. A systematic state-space design method for determining the global switching points of the controller is presented. The synthesized control system can stabilize the maglev vehicle with large initial displacements from an equilibrium. Additionally, the control system possesses a much larger operating region than the classical linear feedback design for the same system. The controller is automatically synthesized by a suite of computational tools that visualize and model the state-space geometry and topology of a given system, use a novel technique of 'flow pipes' to plan global reference trajectories in state space, and navigate the system along the planned trajectories. GRA

N93-21306*# Rensselaer Polytechnic Inst., Troy, NY. Center for Intelligent Robotic Systems for Space Exploration.

COMMAND GENERATOR TRACKER BASED DIRECT MODEL REFERENCE ADAPTIVE CONTROL OF A PUMA 560 MANIPULATOR Thesis

David C. Swift Aug. 1992 211 p

(Grant NAGw-1333)

(NASA-CR-192756; NAS 1.26:192756; RPI-CIRSSE-124) Avail: CASI HC A10/MF A03

This project dealt with the application of a Direct Model Reference Adaptive Control algorithm to the control of a PUMA 560 Robotic Manipulator. This chapter will present some motivation for using Direct Model Reference Adaptive Control, followed by a brief historical review, the project goals, and a summary of the subsequent chapters. Author

N93-21308*# Rensselaer Polytechnic Inst., Troy, NY. Center for Intelligent Robotic Systems for Space Exploration.

LECTURE MATERIALS FOR THE CTOS/MCS INTRODUCTORY COURSE

Keith Fieldhouse, Kevin Holt, Don LeFebvre, Steve Murphy, Dave Swift, and Jim Watson 12 Aug. 1991 287 p

(Grant NAGw-1333)

(NASA-CR-192734; NAS 1.26:192734; RPI-CIRSSE-97) Avail: CASI HC A13/MF A03

On July 18 and 19, 1991 the Center for Intelligent Robotic Systems for Space Exploration presented a course on its robotic testbed support software as it then existed. The course materials are collected as a reflection of the state of those systems at that time. Author

N93-21354*# Rensselaer Polytechnic Inst., Troy, NY. Center for Intelligent Robotic Systems for Space Exploration.

A FAMILY OF ASYMPTOTICALLY STABLE CONTROL LAWS FOR FLEXIBLE ROBOTS BASED ON A PASSIVITY APPROACH

Leonardo Lanari (Rome Univ., Italy.) and John T. Wen (Rome Univ., Italy.) Feb. 1991 40 p

(Grants NAGw-1333; NAG9-462; NSF MSS-89-10437)

(NASA-CR-191870; NAS 1.26:191870; RPI-CIRSSE-85) Avail: CASI HC A03/MF A01

A general family of asymptotically stabilizing control laws is introduced for a class of nonlinear Hamiltonian systems. The inherent passivity property of this class of systems and the Passivity Theorem are used to show the closed-loop input/output stability which is then related to the internal state space stability through the stabilizability and detectability condition. Applications of these results include fully actuated robots, flexible joint robots, and robots with link flexibility. Author

N93-21371*# Rensselaer Polytechnic Inst., Troy, NY. Center for Intelligent Robotic Systems for Space Exploration.

RELIABLE FUSION OF CONTROL AND SENSING IN INTELLIGENT MACHINES Thesis

John E. McInroy Aug. 1991 166 p

(Grant NAGw-1333)

(NASA-CR-192780; NAS 1.26:192780; RPI-CIRSSE-99) Avail: CASI HC A08/MF A02

Although robotics research has produced a wealth of sophisticated control and sensing algorithms, very little research has been aimed at reliably combining these control and sensing strategies so that a specific task can be executed. To improve the reliability of robotic systems, analytic techniques are developed for calculating the probability that a particular combination of control and sensing algorithms will satisfy the required specifications. The probability can then be used to assess the reliability of the design. An entropy formulation is first used to quickly eliminate designs not capable of meeting the specifications. Next, a framework for analyzing reliability based on the first order second moment methods of structural engineering is proposed. To ensure performance over an interval of time, lower bounds on the reliability of meeting a set of quadratic specifications with a Gaussian discrete time invariant control system are derived. A case study analyzing visual positioning in robotic system is considered. The reliability of meeting timing and positioning specifications in the presence of camera pixel truncation, forward and inverse kinematic errors, and Gaussian joint measurement noise is determined. This information is used to select a visual sensing strategy, a kinematic algorithm, and a discrete compensator capable of accomplishing the desired task. Simulation results using PUMA 560 kinematic and dynamic characteristics are presented. Author

N93-21372*# Rensselaer Polytechnic Inst., Troy, NY. Center for Intelligent Robotic Systems for Space Exploration.

ADAPTIVE CONTROL WITH AN EXPERT SYSTEM BASED SUPERVISORY LEVEL Thesis

Gerald A. Sullivan Aug. 1991 233 p

(Grant NAGw-1333)

(NASA-CR-192742; NAS 1.26:192742; RPI-CIRSSE-115) Avail: CASI HC A11/MF A03

Adaptive control is presently one of the methods available which may be used to control plants with poorly modelled dynamics or time varying dynamics. Although many variations of adaptive controllers exist, a common characteristic of all adaptive control schemes, is that input/output measurements from the plant are used to adjust a control law in an on-line fashion. Ideally the adjustment mechanism of the adaptive controller is able to learn enough about the dynamics of the plant from input/output measurements to effectively control the plant. In practice, problems such as measurement noise, controller saturation, and incorrect model order, to name a few, may prevent proper adjustment of the controller and poor performance or instability result. In this work we set out to avoid the inadequacies of procedurally implemented safety nets, by introducing a two level control scheme in which an expert system based 'supervisor' at the upper level provides all the safety net functions for an adaptive controller at the lower level. The expert system is based on a shell called IPEX, (Interactive Process EXpert), that we developed specifically for the diagnosis and treatment of dynamic systems. Some of the more important functions that the IPEX system provides are: (1) temporal reasoning; (2) planning of diagnostic activities; and (3) interactive diagnosis. Also, because knowledge and control logic are separate, the incorporation of new diagnostic and treatment knowledge is relatively simple. We note that the flexibility available in the system to express diagnostic and treatment knowledge, allows much greater functionality than could ever be reasonably expected from procedural implementations of safety nets. The remainder of this chapter is divided into three sections. In section 1.1 we give a detailed review of the literature in the area of supervisory systems for adaptive controllers. In particular, we describe the evolution of safety nets from simple ad hoc techniques, up to the use of expert systems for more advanced supervision capabilities. Author

N93-21373*# Rensselaer Polytechnic Inst., Troy, NY. Center for Intelligent Robotic Systems for Space Exploration.

A DISTRIBUTED PETRI NET CONTROLLER FOR A DUAL ARM TESTBED

Atle Bjanes Jan. 1991 150 p

(Grant NAGw-1333)

(NASA-CR-192733; NAS 1.26:192733; RPI-CIRSSE-82) Avail: CASI HC A07/MF A02

This thesis describes the design and functionality of a Distributed Petri Net Controller (DPNC). The controller runs under X Windows to provide a graphical interface. The DPNC allows users to distribute a Petri Net across several host computers linked together via a TCP/IP interface. A sub-net executes on each host, interacting with the other sub-nets by passing a token vector from host to host. One host has a command window which monitors and controls the distributed controller. The input to the DPNC is a net definition file generated by Great SPN. Thus, a net may be designed, analyzed and verified using this package before implementation. The net is distributed to the hosts by tagging transitions that are host-critical with the

appropriate host number. The controller will then distribute the remaining places and transitions to the hosts by generating the local nets, the local marking vectors and the global marking vector. Each transition can have one or more preconditions which must be fulfilled before the transition can fire, as well as one or more post-processes to be executed after the transition fires. These implement the actual input/output to the environment (machines, signals, etc.). The DPNC may also be used to simulate a Great SPN net since stochastic and deterministic firing rates are implemented in the controller for timed transitions. Author

N93-21390*# Rensselaer Polytechnic Inst., Troy, NY. Center for Intelligent Robotic Systems for Space Exploration.

DISTANCE ESTIMATION AND COLLISION PREDICTION FOR ON-LINE ROBOTIC MOTION PLANNING

K. J. Kyriakopoulos and G. N. Saridis Jan. 1991 28 p
(Grant NAGw-1333)
(NASA-CR-192737; NAS 1.26:192737; RPI-CIRSSE-25) Avail: CASI HC A03/MF A01

An efficient method for computing the minimum distance and predicting collisions between moving objects is presented. This problem has been incorporated in the framework of an in-line motion planning algorithm to satisfy collision avoidance between a robot and moving objects modeled as convex polyhedra. In the beginning the deterministic problem, where the information about the objects is assumed to be certain is examined. If instead of the Euclidean norm, L(sub 1) or L(sub infinity) norms are used to represent distance, the problem becomes a linear programming problem. The stochastic problem is formulated, where the uncertainty is induced by sensing and the unknown dynamics of the moving obstacles. Two problems are considered: (1) filtering of the minimum distance between the robot and the moving object, at the present time; and (2) prediction of the minimum distance in the future, in order to predict possible collisions with the moving obstacles and estimate the collision time. Author (revised)

N93-21391*# Rensselaer Polytechnic Inst., Troy, NY. Center for Intelligent Robotic Systems for Space Exploration.

TASK SEQUENCE PLANNING IN A ROBOT WORKCELL USING AND/OR NETS

Tiehua Cao and Arthur C. Sanderson Jun. 1991 25 p Sponsored in part by the Defense Logistics Agency
(Grant NAGw-1333)
(NASA-CR-192735; NAS 1.26:192735; RPI-CIRSSE-94) Avail: CASI HC A03/MF A01

An approach to task sequence planning for a generalized robotic manufacturing or material handling workcell is described. Given the descriptions of the objects in this system and all feasible geometric relationships among these objects, an AND/OR net which describes the relationships of all feasible geometric states and associated feasibility criteria for net transitions is generated. This AND/OR net is mapped into a Petri net which incorporates all feasible sequences of operations. The resulting Petri net is shown to be bounded and have guaranteed properties of liveness, safeness, and reversibility. Sequences are found from the reachability tree of the Petri net. Feasibility criteria for net transitions may be used to generate an extended Petri net representation of lower level command sequences. The resulting Petri net representation may be used for on-line scheduling and control of the system of feasible sequences. A simulation example of the sequences is described. Author (revised)

N93-21552 Politecnico di Milano (Italy). Dipt. di Elettronica.

A DECOMPOSITION APPROACH TO SUBOPTIMAL CONTROL OF DISCRETE-TIME SYSTEMS

A. Nardini, C. Piccardi, and R. Soncini-Sessa 1992 24 p
(Rept-92-027; ETN-93-93032) Copyright Avail: Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milan, Italy

A suboptimal controller for a class of discrete time systems is presented. The controller is derived by first solving 'offline' a simplified optimal control problem, obtained by neglecting part of the system state and by considering a larger step, and then by solving 'online' at each time step an optimization problem based on the results of the previously solved offline problem. A simple numerical example is presented to illustrate the control scheme. ESA

N93-21802# Science Applications International Corp., San Diego, CA. Foreign Applied Sciences Assessment Center.

NON-US ARTIFICIAL NEURAL NETWORK RESEARCH

Robert B. Davidson Oct. 1991 87 p
(PB93-111508) Avail: CASI HC A05/MF A01

The assessment was undertaken to examine the recent range, quality, and accomplishments of non-US artificial neural network research and development activities. It records the project's initial assessments of major artificial neural network research and development activities in Western Europe, Japan, and the Soviet Union, where the largest, most organized efforts are proceeding or where potential military applications are of interest to US policy-makers. The report focuses on artificial neural networks as an information processing technology, the goal of which is the design and production of powerful computers for appropriate applications. European artificial neural network researchers are equal to the best in the world in model analysis and development. Sponsors of information processing research and development in Japan have made and are continuing to make a major national investment in the development of information processing systems based on artificial neural network technology. GRA

N93-21812*# Carnegie-Mellon Univ., Pittsburgh, PA. Engineering Design Research Center.

AVOIDING SPACE ROBOT COLLISIONS UTILIZING THE NASA/GSFC TRI-MODE SKIN SENSOR Final Technical Report, 15 Nov. 1991 - 14 Dec. 1992

F. B. S. Prinz and S. Mahalingam 14 Dec. 1992 13 p
(Grant NAG5-1468)
(NASA-CR-192292; NAS 1.26:192292) Avail: CASI HC A03/MF A01

A capacitance based proximity sensor, the 'Capaciflector' (Vranish 92), has been developed at the Goddard Space Flight Center of NASA. We had investigated the use of this sensor for avoiding and maneuvering around unexpected objects (Mahalingam 92). The approach developed there would help in executing collision-free gross motions. Another important aspect of robot motion planning is fine motion planning. Let us classify manipulator robot motion planning into two groups at the task level: gross motion planning and fine motion planning. We use the term 'gross planning' where the major degrees of freedom of the robot execute large motions, for example, the motion of a robot in a pick and place type operation. We use the term 'fine motion' to indicate motions of the robot where the large dofs do not move much, and move far less than the mirror dofs, such as in inserting a peg in a hole. In this report we describe our experiments and experiences in this area. Derived from text

N93-21847# Oak Ridge National Lab., TN.

USE OF NEURAL NETWORKS IN THE ANALYSIS OF COMPLEX SYSTEMS

R. E. Uhrig (Tennessee Univ., Knoxville.) 1992 10 p Presented at the WNN-1992: Workshop on Neural Networks, Alburn, AL, 10-12 Feb. 1992
(Contracts DE-FG07-88ER-12824; DE-AC05-84OR-21400)
(DE93-003554; CONF-9202142-1) Avail: CASI HC A02/MF A01

The application of neural networks, alone or in conjunction with other advanced technologies (expert systems, fuzzy logic, and/or genetic algorithms) to some of the problems of complex engineering systems has the potential to enhance the safety reliability and operability of these systems. Complex systems or parts of such systems that can be isolated from the total system are addressed. Typically, the measured variables from the systems are analog variables that must be sampled and normalized to expected peak values before they are introduced into neural networks. Often data must be processed to put it into a form more acceptable to the neural network. The neural networks are usually simulated on modern high-speed computers that carry out the calculations serially. However, it is possible to implement neural networks using specially designed microchips where the network calculations are truly carried out in parallel, thereby providing virtually instantaneous outputs for each set of inputs. Specific applications described include: diagnostics: state of the plant; hybrid system for transient identification; detection of change of mode in complex systems; sensor validation; plant-wide monitoring; monitoring of performance and efficiency; and analysis of vibrations. Although the specific examples described deal with nuclear power plants or their subsystems, the techniques described can be applied to a wide variety of complex engineering systems. DOE

N93-21848# Tennessee Univ., Knoxville. Dept. of Nuclear Engineering.
MONITORING OF VIBRATING MACHINERY USING ARTIFICIAL NEURAL NETWORKS
I. E. Alguindigue, A. Loskiewicz-Buczak, and R. E. Uhrig 1991 6 p Presented at the 2nd Government Neural Network Applications Workshop, Huntsville, AL, 10-12 Sep. 1991
(Contracts DE-FG07-88ER-12824; DE-AC05-84OR-21400)
(DE93-003566; CONF-9109447-1) Avail: CASI HC A02/MF A01

The primary source of vibration in complex engineering systems is rotating machinery. Vibration signatures collected from these components render valuable information about the operational state of the system and may be used to perform diagnostics. For example, the low frequency domain contains information about unbalance, misalignment, instability in journal bearing, and mechanical looseness; analysis of the medium frequency range can render information about faults in meshing gear teeth; while the high frequency domain will contain information about incipient faults in rolling-element bearings. Trend analysis may be performed by comparing the vibration spectrum for each machine with a reference spectrum and evaluating the vibration magnitude changes at different frequencies. This form of analysis for diagnostics is often performed by maintenance personnel monitoring and recording transducer signals and analyzing the signals to identify the operating condition of the machine. With the advent of portable fast Fourier transform (FFT) analyzers and 'laptop' computers, it is possible to collect and analyze vibration data an site and detect incipient failures several weeks or months before repair is necessary. It is often possible to estimate the remaining life of certain systems once a fault has been detected. RMS velocity, acceleration, displacements, peak value, and crest factor readings can be collected from vibration sensors. To exploit all the information embedded in these signals, a robust and advanced analysis technique is required. Our goal is to design a diagnostic system using neural network technology, a system such as this would automate the interpretation of vibration data coming from plant-wide machinery and permit efficient on-line monitoring of these components. DOE

N93-20706# Wright State Univ., Dayton, OH. Dept. of Mechanical and Materials Engineering.
COMPUTER-ORIENTED CLOSED-FORM ALGORITHM FOR CONSTRAINED MULTIBODY DYNAMICS FOR ROBOTICS APPLICATION
Junghsen Lieh *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 646-647 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20838# Technion - Israel Inst. of Tech., Haifa. Faculty of Industrial and Management Engineering.
STATISTICAL PROCESS CONTROL (SPC) IN FMS/CIM SYSTEMS
Gideon Halevi *In* CASA-RI/SME, Proceedings of the International Conference on CAD/CAM and AMT. Volume 2: CIRP Sessions on Tolerancing, for Function in a CAD/CAM Environment 14 Dec. 1989 8 p (For primary document see N93-20823 07-61)
(Paper-C-3-4) Avail: CASI HC A02/MF A02

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N93-20008# Santa Fe Inst., NM.
THE 1991 LECTURES IN COMPLEX SYSTEMS Final Report, 1 Apr. 1991 - 31 Mar. 1992
Lynn Nadel and Daniel Stein 5 Aug. 1992 489 p
(Contract N00014-91-J-1673)
(AD-A259428) Avail: CASI HC A21/MF A04

This four-week school consisted of seven short courses together with seminars, computer workshops, and experimental labs supplementing the lectures. The first week of the school focussed on introductory material. The final three weeks were devoted to lectures on specific topics. The goal of the summer school is to provide graduate students and postdoctoral fellows with an introduction to the study of complex behavior in mathematical, physical, and living systems. The emphasis is on developing techniques to the study of specific systems. Topics include nonlinear dynamics, neural nets and computational neurobiology, lattice gases, pattern formation in biological systems, and design of parallel-processing algorithms. GRA

N93-20267# National Inst. for Fusion Science, Nagoya (Japan).
EIGENFUNCTION FOR DISSIPATIVE DYNAMICS OPERATOR AND ATTRACTOR OF DISSIPATIVE STRUCTURE
Yoshiomi Kondoh (Gunma Univ., Japan.) Oct. 1992 13 p Submitted for publication
(NIFS-194; AD-B169724L) Avail: CASI HC A03/MF A01

It is shown that the states with the minimum dissipation rate in general dissipative dynamics systems are expressed by the eigenfunctions for the dissipative dynamics operators. The eigenfunctions for the dissipative dynamics operators are shown to constitute the self-organized and self-similar decay phase as the attractor of the dissipative structure.
Author

N93-20327# Maryland Univ., Baltimore. Dept. of Mathematics.
HIGHER ORDER CROSSINGS Final Report, 1 Oct. 1988 - 30 Sep. 1992
Benjamin Kedem Sep. 1992 10 p
(Grant AF-AFOSR-0049-89)
(AD-A258727; AFOSR-92-0953TR) Avail: CASI HC A02/MF A01

In the research on higher order crossings (HOC) they have solved some of the mathematical/statistical problems associated with a certain contraction mapping method for frequency detection and estimation in the presence of noise. They can now tell how to shrink the filters bandwidth to achieve almost sure convergence of the HOC sequence. The sample first order autocorrelation in filtered data is called a higher order correlation, or HOC again. Given the close association between the two types of HOC, these two types of HOC are in fact equivalent under some conditions the nonlinear least squares precision using O(N) computational complexity, but without any matrix inversion and/or other complicated calculations.
GRA

N93-20391# Army Construction Engineering Research Lab., Champaign, IL.
LEAST SQUARE METHODS FOR SOLVING SYSTEMS OF INEQUALITIES WITH APPLICATION TO AN ASSIGNMENT PROBLEM Final Report
Janet H. Spoonamore Nov. 1992 89 p
(AD-A258682; CERL-TM-FF-93/03) Avail: CASI HC A05/MF A01

This research addresses algorithmic approaches for solving two related types of optimization problems: (1) solving a specific type of assignment problem using continuous methods; and (2) solving systems of inequalities (and equalities) in a least square sense. The specific assignment problem has piece-wise linear additive separable server cost functions, which are continuous everywhere except at zero, the point of discontinuity for the assignment condition. Continuous relaxation of the consults yields a linear programming problem. Solving the dual of the linear programming problem yields the complementarity conditions for a primal solution, a system of linear inequalities and equalities. Adding equations to this system to enforce a solution in the relaxed solution set yields an augmented system, not necessarily linear. Methods to solve this system, a system of linear inequalities and non-linear equations, in a least square sense are developed. Common algorithmic approaches to solve nonlinear least square problems are adapted to solve systems of inequalities. Local and global convergence results are developed. Rates of convergence are analyzed. Applications of the algorithms for solving the piece-wise linear assignment subproblem are developed and analyzed. Application of the algorithms for solving linear programming problems, and linear and convex complementarity problems are described. GRA

N93-20589# Air Force Academy, CO.
LINEAR ALGEBRA APPLIED TO PHYSICS DETERMINING SMALL VIBRATIONS IN CONSERVATIVE ELASTIC SYSTEMS Final Report
Shirley J. Hamilton 4 Nov. 1992 128 p
(AD-A259114; USAFA-TR-92-5) Avail: CASI HC A07/MF A02

The purpose of this application was to create a supplement to an undergraduate course in linear algebra. This application was drawn from the field physics and shows how linear algebra is used to solve systems of second order linear differential equations, which could be used to model

small vibrations in molecules. This application was designed so that an instructor of linear algebra could use it either as an independent study project or as an integrated part of the course. GRA

N93-20737# Sheffield Univ. (England). Dept. of Control Engineering.
EXPLICIT REPRESENTATIONS OF LYAPUNOV FUNCTIONS FOR STABLE ANALYTIC SYSTEMS
S. P. Banks Aug. 1990 11 p
(RR-402; ETN-92-92762) Avail: CASI HC A03/MF A01

An explicit series expansion for a Lyapunov function for a nonlinear analytic system is presented using Lie series. In the general case of not necessarily exponentially stable systems, the state can be augmented and the problem reduced to that of a nonautonomous exponentially stable system. The solution is given as a Taylor series expansion with an explicit characterization of the coefficients of the monomials in the state space coordinates. These coefficients can be evaluated approximately, possibly by using a computer algebra package. ESA

N93-20738# Sheffield Univ. (England). Dept. of Control Engineering.
GLOBAL STABILIZATION OF LINEAR ANALYTIC SYSTEMS
S. P. Banks and B. J. Mass Aug. 1990 16 p
(RR-403; ETN-92-92763) Avail: CASI HC A03/MF A01

A technique for the choice of a stable, and globally attracting switching surface for a linear analytic system assuming discontinuous feedback, is implemented. The method is based on the solution of a pair of coupled partial differential equations, and a geometrical alternative is derived. Only mild conditions are required to be satisfied by the system. A generalization to systems expressed as polynomials in the control is considered. The basic partial differential equation for the switching manifold is derived and the stability of the switching manifold is shown. The method can be implemented by solving a pair of coupled partial differential equations or by satisfying geometrical conditions. It is demonstrated that even in simple examples, this can lead to strange switching surfaces which could not be predicted by other methods. ESA

N93-20782# Grenoble-1 Univ. (France). Lab. de Modelisation et Calcul.
CALCULATION OF THE JORDAN FORM OF A MATRIX WITH RATIONAL COEFFICIENTS (USING THE FORMAL COMPUTATION SYSTEM AXIOM) [CALCUL DE AL FORME DE JORDAN D'UNE MATRICE A COEFFICIENTS RATIONNELS (EN UTILISANT LE SYSTEME DE CALCUL FORMEL AXIOM)]
Isabelle Gil Apr. 1992 35 p In FRENCH
(RR-882-M; ETN-93-92711) Avail: CASI HC A03/MF A01

An algorithm for computing the Jordan form of a square matrix with rational coefficients using the computer algebra system Axiom and an IBM R.S.6000/320 with 24 Mb memory is presented. The general method, which is essentially based on the use of the Frobenius form of the matrix in order to compute its Jordan form, is described. The algorithm 'froben' which computes the Frobenius form of a matrix is streamlined, the transformation from the Frobenius form to the Jordan form is detailed, and the so called algorithm 'Jordform' is given. The complexity of this algorithm is studied and the algorithm is proved to be polynomial. The computation of the matrix exponential using the Jordan form is explained. ESA

N93-20784# Grenoble-1 Univ. (France). Lab. de Modelisation et Calcul.
DYNAMIC SYSTEMS AND NORMAL FORMS [SYSTEMES DYNAMIQUES ET FORMES NORMALES]
Laurent Stolovitch 15 Apr. 1992 51 p In FRENCH
(RR-883-M; ETN-93-92712) Avail: CASI HC A04/MF A01

Definitions and theorems relating to the existence of solutions of differential equations are recalled. The notion of diffeomorphism and its action on a vector field are addressed. Equivalence and Lie algebra of vector fields and singular point and stability are reported. Hartman-Grobman theorems in diffeomorphism and vector fields are considered. Normal forms are studied for the formal, differentiable and analytical cases, and a calculation algorithm is described. Applications of normal form theory and the calculations developed are described. A demonstration of the Dunford theorem is given. ESA

N93-20787# Grenoble-1 Univ. (France). Lab. de Modelisation et Calcul.
NON STANDARD ANALYSIS AND ORDINARY DIFFERENTIAL EQUATIONS Thesis, 24 Jun. 1991 [ANALYSE NON STANDARD ET EQUATIONS DIFFERENTIELLES ORDINAIRES]
Jacques-Arthur Weil Apr. 1992 64 p In FRENCH
(RR-884-M; ETN-93-92713) Avail: CASI HC A04/MF A01

The concepts of non standard analysis and theoretical aspects of possible arithmetic choices are presented. Slow-fast fields, related results, tools used, and the implementation of these tools, are reported. The following problems are addressed: desingularization at infinity, singular perturbations, and regular perturbations. An illustration of the use of infinitesimal analysis is given. ESA

N93-20800# Grenoble-1 Univ. (France).
ON THE EXISTENCE OF (0,2)-GRAPH OF ORDER 18 [SUR L'EXISTENCE DE (0,2)-GRAPHE D'ORDRE 18]
Rafai-Mourad Madani (Universite des Sciences et de la Technologie Houari Boumediene, Algiers, Algeria.) Apr. 1992 12 p In FRENCH
(RR-887-I; ETN-93-92718) Avail: CASI HC A03/MF A01

Simple graphs G = (V,E), where V signifies the vertices and E the edges are considered. A proof which shows that (0,2)-graph of order 18 does not exist is given. ESA

N93-20803# Grenoble-1 Univ. (France). Lab. d'Informatique Fondamentale et d'Intelligence Artificielle.
A GENTZEN-SYSTEM FOR CTL
J. V. Echague Nov. 1991 22 p
(RR-865-I-IMAG-122-LIFIA; ETN-93-92719) Avail: CASI HC A03/MF A01

A sound and complete Gentzen System (G(CTL)) for Computation Tree Logic (CTL) is presented. Two proofs of completeness are given: the first one shows that G(CTL) is equivalent to the system proposed in a referenced study and the second one uses Henkin method. The latter gives, as a by product, a weak version of the normal form theorem for G(CTL): the cut rule can be removed from G(CTL) without changing the set of theorems. In systems for classical propositional logic this result entails decidability. However, this is not the case here, due to the existence of essential induction rules. Finite theories and a deduction theorem are also introduced. ESA

N93-20805# Rome Univ. (Italy). Dipt. di Fisica.
C-INTEGRABLE NONLINEAR PDE'S. 1
F. Calogaro (Istituto Nazionale di Fisica Nucleare, Rome, Italy.) and Ji Xiaoda (Istituto Nazionale di Fisica Nucleare, Rome, Italy.) 20 Feb. 1991 40 p Submitted for publication
(Preprint-787; ETN-93-92897) Avail: CASI HC A03/MF A01

A technique to generate C-integrable nonlinear Partial Differential Equations (PDE's) is reported. C-integrable nonlinear PDE's are nonlinear PDE's solvable by an appropriate change of variables. The C-integrable nonlinear PDE's provide a theoretical environment to understand nonlinear phenomena such as the elastic scattering of solitons, a particular kind of inelastic scattering of solitons, and the possibility to solve problems such as certain initial boundary value problems. The technique introduced is based on a change of dependent variables. The equations of C-integrable PDE's obtained via linear and quadratic conservation laws are presented. The equations for n = 1, n = 2, and for arbitrary n are discussed. ESA

N93-20840# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
FAST THEOREM PROVING IN INTUITIONISTIC PROPOSITIONAL LOGIC
Max I. Kanovich (Tver State Univ., Russia.) Dec. 1991 18 p Sponsored in part by Netherlands Organization for Scientific Research
(CWI-CS-R9157; ETN-92-92498) Copyright Avail: CASI HC A03/MF A01

The decision problem for Intuitionistic propositional logic (Int) is considered: a computational semantics is introduced for relational knowledge bases, the semantics naturally arising from practical experience of databases and knowledge bases; it is stated that the corresponding logic coincides exactly with the intuitionistic one; methods of proof of the general theorems turn out to be very useful for designing new efficient algorithms. In particular, on the basis of a specific calculus of tasks related to this computational

interpretation, an efficient prove or disprove algorithm is designed with the following properties: for an arbitrary intuitionistic propositional formula, the algorithm runs in linear deterministic space; for every 'reasonable' formula, the algorithm runs in 'reasonable' time, despite the fact that in theory it has an 'exponential' uniform lower bound. Note that in view of the PSPACE completeness of propositional intuitionistic logic an exponential execution time can be expected in the worst case. But such cases only arise for very unnatural formulas, that is for formulas that even in their best solution need maximal crosslinking of all their possible subtasks. The theorem prover was implemented in PASCAL. ESA

N93-20852# Technische Univ., Delft (Netherlands). Faculty of Mathematics and Informatics.

SINGULAR POINTS AT INFINITY OF QUADRATIC SYSTEMS OF DIFFERENTIAL EQUATIONS

J. W. Reyn and R. E. Kooij 1991 52 p

(Rept-91-58; ETN-93-92019) Copyright Avail: CASI HC A04/MF A01

Singular points at infinity of quadratic systems of differential equations in the plane are studied. A detailed description of the possible singular points is given as well as the conditions on the coefficients for which they occur. The only restriction is that it is assumed that the singular point is at the end of the x axis. In particular, the index of the point and its multiplicity in the tangential and transversal directions with respect to the Poincare circle are determined. ESA

N93-20853# Technische Univ., Delft (Netherlands). Faculty of Mathematics and Informatics.

RESOLUTION IN MODAL PROPOSITIONAL LOGIC

R. Sommerhalder and S. C. vanWestrhenen 1991 49 p

(Rept-91-59; ETN-93-92020) Copyright Avail: CASI HC A03/MF A01

An extension of the classical resolution method to the propositional modal logics K, D, T S(sub 4), and S(sub 5) is addressed. The intuition behind the rules as defined has not become obvious and the rules seem somewhat complicated. A system for resolution in modal propositional logics which is intuitively transparent is defined. Soundness and completeness proofs for the systems K, D, T S(sub 4), and S(sub 5) are detailed. A definition of the rules is given, making a distinction between resolution rules and simplification rules. In contrast to the rules defined by previous researchers, the resolution rules are independent of the modal system but the simplification rules depend on the system at hand. Performing a resolution step is defined as applying a resolution rule and subsequently applying any number of simplification rules. Although the rules differ, this is basically the same as in the previous systems. The soundness and completeness proofs are of course not identical to, but often very similar to, those of the previous work. The completeness proof is based on a normalized version of a semantic tableaux represented as trees. These trees are different from the semantic trees used by previous researchers. Also, the rules applied at the nodes of the tree are the same in all systems apart from D, whereas the earlier work has tree rules that depend on the system at hand. ESA

N93-20854# Technische Univ., Delft (Netherlands). Faculty of Mathematics and Informatics.

ON HOMOGENEOUS QUASILINEAR EVOLUTION EQUATION

Shuanhu Li 1991 21 p

(Rept-91-65; ETN-93-92021) Copyright Avail: CASI HC A03/MF A01

Quasi-linear evolution equations of the form u(dot) + A(u)u = 0, are studied in a general Banach space E(sub 0). A(u) is assumed, for each fixed argument, the infinitesimal generator of a strongly continuous analytic semigroup, such that the domain E(sub 1) of A(u) is independent of u. The equation is studied in complex interpolation spaces E(sub theta) between E(sub 0) and E(sub 1), and it is shown to possess a unique maximal solution, which depends (Lipschitz-) continuously upon its initial value. ESA

N93-20860# Institut National de Recherche d'Informatique et d'Automatique, Le Chesnay (France). Programme 1: Architectures Paralleles, Bases de Donnees, Reseaux et Systemes Distribues.

STOCHASTIC ORDERINGS ON PARTIAL SUMS OF RANDOM VARIABLES AND ON COUNTING MEASURES OF RANDOM INTERVALS [ORDONNANCEMENT STOCHASTIQUE DE SOMMES PARTIELLES DE VARIABLES ALEATOIRES ET DE MESURES DE COMPTAGE D'INTERVALES ALEATOIRES]

Alain Jean-Marie and Zhen Liu 11 Apr. 1991 40 p

(INRIA-RR-1422; ETN-93-92642) Avail: CASI HC A03/MF A01

Relationships are established between the stochastic ordering of random variables, of their random partial sums, and of counting measures of random intervals. Two types of results are obtained. Conditions are given under which a stochastic ordering between sequences of random variables is inherited by (vectors of) random partial sums of these variables. These results extend and generalize theorems of Borovkov, Ross, and Stoyan. Conditions are provided under which the counting measures of a given point process in two ordered random intervals are also ordered. These results are applied to several comparison problems in queueing systems. It is shown that if the service times in two M/GI/1 systems compare for some stochastic ordering, the busy periods compare for the same ordering. Various bounds on waiting times and response times are provided for queues with bulk arrivals. The cyclic and Bernoulli policies for customer allocation to parallel queues are compared in the transient regime. Stochastic ordering relations are established for the cycle times in polling systems. ESA

N93-20861# Institut National de Recherche d'Informatique et d'Automatique, Le Chesnay (France). Programme 2: Calcul Symbolique, Programmation et Genie Logiciel.

A CANONICAL CALCULUS OF RESIDUALS [UN CALCUL CANONIQUE DES RESIDUS]

Yves Bertot Oct. 1991 14 p

(INRIA-RR-1542; ETN-93-92664) Avail: CASI HC A03/MF A01

A formal language to describe origin functions, which permit the study of the notions of descendance and residuals in reduction systems, is introduced. Computations on this formal language are defined using a term rewriting system, which is shown to be canonical. This work has application in semantics and debugging. ESA

N93-20862# Technische Univ., Delft (Netherlands). Faculty of Mathematics and Informatics.

DISCRETE ORTHOGONAL WAVELETS

P. L. Vermeer 1991 48 p

(Rept-91-45; ETN-93-92014) Copyright Avail: CASI HC A03/MF A01

The problem of whether it is possible to develop a theory for the construction of a multiresolution and subband representation for discrete signals is addressed. This means that the filter connecting a certain scale or subband to the original signal should also be discrete time. To this end, the construction of discrete orthonormal wavelet bases, which are orthonormal wavelet bases for the space of discrete time, square summable functions, is described. ESA

N93-20865# Technische Univ., Delft (Netherlands). Faculty of Mathematics and Informatics.

THE SEARCH FOR DIFFERENTIAL EQUATIONS FOR ORTHOGONAL POLYNOMIALS BY USING COMPUTERS

Roelof Koekoek 1991 28 p

(Rept-91-55; ETN-93-92017) Copyright Avail: CASI HC A03/MF A01

A method to discover a linear differential equation satisfied by polynomials, which are defined as a linear combination of classical orthogonal polynomials and their derivatives, is described. The method makes use of counteralgebra packages like Maple and Mathematica. Both packages easily do the calculations, however they use a lot of computer memory. On a workstation with 8 mbytes of internal memory some calculations took several hours. Preliminary results are given. ESA

N93-20870# Institut National de Recherche d'Informatique et d'Automatique, Le Chesnay (France). Programme 2: Calcul Symbolique, Programmation et Genie Logiciel.

THE ORIGINS OF LAMBDA-CALCULUS AND TERM REWRITING SYSTEMS [LES ORIGINES DU LAMBDA-CALCUL ET DES SYSTEMES DE REECRITURE]

Yves Bertot Oct. 1991 21 p

(INRIA-RR-1543; ETN-93-92665) Avail: NTIS HC A03/MF A01

Origin functions are used to describe the notions of descendance and residuals in reduction systems such as the lambda calculus and linear term rewriting systems. The original functions of the lambda calculus and for term rewriting systems that implement this calculus, lambda-sigma and lambda-Env, are compared. The notions of origin are shown not to correspond exactly, but an extension of the notion of origin that permits the correct computation of lambda calculus origins for derivations of lambda-Env is described. The extension is shown not sufficient to give the same result of lambda-sigma and another extension for that system is given. This work is interesting as it provides a distinction between the two term rewriting systems. This work has applications in the debugging of languages based on the lambda calculus or environments. ESA

N93-20873# Grenoble-1 Univ. (France). Lab. de Modelisation et Calcul.

AN ORDER-THEORETIC UNIFICATION AND GENERALISATION OF CERTAIN FUNDAMENTAL BIJECTIONS IN MATHEMATICAL CLASSIFICATION, 1

Frank Critchley and Bernard VanCutsem Jan. 1992 30 p Sponsored by Royal Society, and Warwick Research and Innovative Funds Prepared in cooperation with Warwick Univ.

(RR-874-M; ETN-93-92703) Avail: CASI HC A03/MF A01

A study which shows that a single, simple order-theoretic result unifies and generalizes seven familiar and fundamental bijections in mathematical classification is presented. Considerable attention is given to providing counterexamples indicating the senses in which the results presented are best possible. The generalizations given open up a wide range of methodological advances. These include the ability to treat multiattribute disimilarities, asymmetry, and asymptotics within a single coherent mathematical framework. ESA

N93-20874# Rome Univ. (Italy). Dipt. di Fisica.

C-INTEGRABLE NONLINEAR PDE'S. 2

F. Calogero (Istituto Nazionale di Fisica Nucleare, Rome, Italy.) and Ji Xiaoda (Istituto Nazionale di Fisica Nucleare, Rome, Italy.) 20 Feb. 1991 37 p Submitted for publication

(Preprint-788; ETN-93-92898) Avail: CASI HC A03/MF A01

A technique to generate C-integrable nonlinear Partial Differential Equations (PDE's) is reported. C-integrable nonlinear PDE's are nonlinear PDE's solvable by an appropriate change of variables. The C-integrable nonlinear PDE's provide a theoretical environment to understand nonlinear phenomena, such as the elastic scattering of solitons, a particular kind of inelastic scattering of solitons, and the possibility of solving problems such as certain initial boundary value problems. The technique introduced is based on a change of independent variables. The equations for the case when only one variable is transformed are discussed. Concerning the scalar equations, a general class of equations and a list of integrable equations are given. Examples involving two-vector and n-vector are included. Representative examples for the situation in which the change of variable is applied to equations that feature an explicit dependence on the independent variable are presented. ESA

N93-20890# Loughborough Univ. of Technology (England). Dept. of Mathematical Sciences.

ON A FUNDAMENTAL NOTION OF EQUIVALENCE IN LINEAR SYSTEMS THEORY

A. C. Pugh, N. P. Karampetakis (Aristotle Univ. of Thessaloniki, Greece.), G. E. Hayton (Hull Univ., England.), and A. I. G. Vardulakis (Aristotle Univ. of Thessaloniki, Greece.) Jun. 1992 15 p

(Maths-Rept-A-162; ETN-92-92758) Avail: CASI HC A03/MF A01

A fundamental form of equivalence between two homogeneous systems of ordinary differential equations is defined in terms of isomorphisms between the 'finite' and 'infinite' solution sets. This equivalence is an alternative characterization of the transformation of full equivalence in the case of nonsingular matrices. This characterization enabled the true nature and role of the conditions of full equivalence in the case where square and nonsingular polynomial matrices are involved. Thus the McMillan degree conditions are seen to be vital in a quite fundamental way. It is concluded that the transformation of full equivalence, with its various characterizations, is the basic transformational tool for the simultaneous study of the finite and finite frequency behavior of general autonomous systems. ESA

N93-20901# Institut National Polytechnique, Grenoble (France). Lab. de Modelisation et Calcul.

CONTRIBUTION TO COMPUTER ARITHMETIC Ph.D. Thesis [CONTRIBUTION A L'ARITHMETIQUE DES ORDINATEURS]

Yvan Herreros 1991 157 p In FRENCH

(ETN-93-92680) Avail: CASI HC A08/MF A02

Some problems occurring in computer arithmetic are discussed. A survey on number systems is presented. A modification of Avizienis' algorithm, which makes it possible to perform carry free additions under less restrictive conditions, is included. The multiplication of large integers is discussed. An efficient implementation of an algorithm of Pollard is presented and compared to other algorithms. On line computations are studied: functions provided that they are sufficiently regular are given. A new number system for representing complex numbers called 'polygonal representation' is proposed. It allows constant time additions and makes online complex arithmetic operations possible. ESA

N93-20903# Rome Univ. (Italy). Dipt. di Fisica.

ON A POSSIBLE NON-LORENTZIAN ENERGY-DEPENDENCE OF THE K NEUTRAL(SUB S)

F. Cardone (Istituto Nazionale di Fisica Nucleare, Rome, Italy.), R. Mignani (Istituto Nazionale di Fisica Nucleare, Rome, Italy.), and R. M. Santilli (Institute for Basic Research, Palm Harbor, FL.) 11 Jun. 1991 8 p Submitted for publication

(Preprint-807; ETN-93-92916) Avail: CASI HC A02/MF A01

A fit to the experimental data reported by Aronson on the (K(0))(sub S) lifetime shows a good agreement with a generalized expression for time dilation, obtained by a Lie isotopic lifting of the Poincare symmetry. The aim is to provide a different interpretation of the nonlinearity of the K neutral(sub S) lifetime behavior, in the range of 35 to 110 GeV, and taking into account the isotopic law. ESA

N93-20940# Ecole Nationale Superieure des Telecommunications, Paris (France). Groupe Image.

FUZZY CONNECTIVITY AND MATHEMATICAL MORPHOLOGY [CONNEXITE FLOUE ET MORPHOLOGIE MATHEMATIQUE]

Isabelle Bloch Jan. 1992 12 p In FRENCH

(TELECOM-Paris-92-D-001; ETN-93-92692) Avail: CASI HC A03/MF A01

An equivalence between the degree of connectivity defined for fuzzy sets and the connection cost defined on gray scale mathematical morphology framework is proven. Definitions and properties of both concepts are presented. The method combines two different formalisms: one concerning decision and the other concerning morphological analysis. The fuzzy sets solve problems involving classification and the connectivity is applied to most algorithms. The gray scale mathematical morphology is based on neighborhood operations and the connection cost allows to define a topographic distance from which a morphological topography is defined. ESA

N93-20945# Grenoble-1 Univ. (France). Lab. Artemis.

FORCING COLORATIONS, INTERVALS AND THE PERFECT GRAPH CONJECTURE (AN EXTENDED ABSTRACT)

Andras Sebo Nov. 1991 11 p

(RR-867-M; ETN-93-92699) Avail: CASI HC A03/MF A01

A study on Strong Perfect Graph Conjecture (SPGC) is presented. One direction of general results is summarized with some notions defined: Lovasz's theorem on partitionability; Padberg's corollaries; Chvatal's remarks on transversals. The characterization of unique colorability is addressed. A step forward in proving that a minimal imperfect graph with 'enough combinatorial forcing' is a hole or an antihole is attempted. The following generalized theorem is proved: if a minimal imperfect graph G has adjacent forced vertices, then G is a hole or antihole. Theorems relating to the following are given: critical edges and the PGC, unique colorability and

critical edges; local structure and (omega - 1) cliques. A selection of reformulations of the SPGC which follow from the results of the study are given. ESA

N93-20946# Grenoble-1 Univ. (France). Lab. Artemis.
GENERAL ANTIFACTORS OF GRAPHS
Andras Sebo Dec. 1991 12 p
(RR-868-M; ETN-93-92700) Avail: CASI HC A03/MF A01

A study on antifactors of graphs which considers the following problem is addressed: in a superstitious company everybody has numbers that he thinks to be unlucky for himself; when they meet, everybody wants to shake hands with some of his acquaintances, but nobody wants to shake hands with an unlucky number of acquaintances; when can this be successful? This question occurs in Lovasz, where the case when everyone has one unlucky number (antifactor problem) is answered. A 'Tutte type good characterization', (and a simple polynomial algorithm) to decide this question when several unlucky numbers are allowed, but none in the company has two neighboring unlucky numbers, is given. ESA

N93-20947# Grenoble-1 Univ. (France). Lab. Artemis.
A GENERALIZED CUT CONDITION FOR MULTIFLOWS IN MATROIDS
Werner Schwaerzler (Bonn Univ., Germany.) and Andras Sebo Jan. 1992 18 p
(RR-869-M; ETN-93-92701) Avail: CASI HC A03/MF A01

The class of binary matroids for which the so called 'cut-condition' is not only necessary but also sufficient for the existence of a multiflow was characterized by P. Seymour. A natural generalization of the cut-condition is formulated and a characterization of the corresponding larger class of matroids is characterized in terms of forbidden minors. ESA

N93-20948# Grenoble-1 Univ. (France). Lab. Artemis.
COUNTEREXAMPLES TO THREE CONJECTURES CONCERNING PERFECT GRAPHS
Stephan Hougardy (Bonn Univ., Germany.) Dec. 1991 9 p
(RR-870-M; ETN-93-92702) Avail: CASI HC A02/MF A01

Counterexamples to a conjecture of Hoang, a conjecture of Hertz and de Werra and to a conjecture of Reed are presented. All these three conjectures are related to perfect graphs. The conjectures concern alternatively orientable graphs, even pairs, and Berge graphs. ESA

N93-20950# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
TRIANGULATING PLANAR GRAPHS WHILE MINIMIZING THE MAXIMUM DEGREE
Goos Kant and Hans L. Bodlaender Feb. 1992 26 p
(Contract EEC-3075)
(RUU-CS-92-07; ETN-93-92807) Avail: CASI HC A03/MF A01

The problem of triangulating a planar graph G while minimizing the maximum degree Delta(G') of the resulting triangulated planar graph G' is studied. This problem is shown to be NP complete. Worst case lower bounds for Delta(G') with respect to Delta(G) are given. A linear algorithm to triangulate planar graphs, for which the maximum degree of the triangulated graph is only a constant larger than the lower bounds, is described. The triangulation of one face while minimizing the maximum degree is shown to be achievable in polynomial time. The algorithm is used to obtain a polynomial exact algorithm to triangulate the interior faces of an outerplanar graph while minimizing the maximum degree. ESA

N93-20957# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
AN ANALOGUE OF PHILON'S LINE IN n DIMENSIONS
W. W. E. Wetterling Feb. 1992 10 p
(MEMO-1032; ETN-93-92460) Avail: CASI HC A02/MF A01

The generalization of the extremum property of a line segment in the plane to an extremum property of a hyperplane segment in n dimensional (Euclidean) space is addressed. The problem of minimizing the (n - 1) volume Phi(b) of K intersection H(b), where K is a convex cone in the set of real numbers to the nth power and H(b) a hyperplane through a given point p, is considered. A geometric interpretation of the first order optimality condition is given. The special case n = 2 is known as a characteristic property of Philon's line. ESA

N93-21009# Amsterdam Univ. (Netherlands). Dept. of Mathematics and Computer Science.
MAXIMAL KRIPKE-TYPE SEMANTICS FOR MODAL AND SUPERINTUITIONISTIC PREDICATE LOGICS
Dmitrij P. Skvortsov (Institute of Scientific and Technical Information, Moscow, Russia.) and Valentin B. Shehtman May 1992 41 p
(ML-92-02; ETN-93-93092) Avail: CASI HC A03/MF A01

The semantics for 'superintuitionistic' logics (extensions of Heyting's predicate calculus) and 'modal' logics (extensions of S4 quantified) are addressed. In particular, the following are studied: predicate logics and Kripke type semantics; metaframes; completeness in metaframe semantics; representation theorems. It is hoped that the ideas can be applied to a larger class of logics as well. ESA

N93-21034# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
AN ORDER-THEORETIC MODEL FOR THE ALGEBRA OF COMMUNICATING PROCESSES
P. M. W. Knijnenburg Jan. 1992 25 p
(RUU-CS-92-02; ETN-93-92802) Avail: CASI HC A03/MF A01

An order theoretic interpretation for the process algebra ACP (Algebra for Communicating Processes) is developed. It is shown to be a model for the theory by showing that the axioms for CP hold on the interpretation. The model is shown to be complete in the sense that two ACP terms are equal if and only if they are equal in the model. ESA

N93-21050# Grenoble-1 Univ. (France). Lab. de Modelisation et Calcul.
AN ESTIMATING FUNCTION FOR A SCALAR PARAMETER IN A COVARIANCE OPERATOR
A. Antoniadis and C. Lavergne Feb. 1992 16 p
(RR-878-M; ETN-93-92707) Avail: CASI HC A03/MF A01

Results on an estimating function for producing estimates of a scalar parameter contained multiplicatively in the covariance operator of strongly second order m dimensional Random Vector (RV) are presented. The asymptotic properties of estimates obtained when observing n independent and identically distributed RVs on the model are studied. Under modest assumptions, the consistency and the asymptotic normality of the obtained sequences of estimates are ascertained. The theory is illustrated by an example from reliability and the estimates are compared to maximum likelihood variance components estimates via simulations. ESA

N93-21068# Technische Univ., Berlin (Germany). Fachbereich Mathematik.
CONFORMAL LENGTH OF GRAPHS Ph.D. Thesis [KONFORMLAENGE VON GRAPHEN]
Michelle Brehm 1992 87 p In GERMAN
(ETN-93-93419) Avail: CASI HC A05/MF A01

A definition of the conformal length of a graph is given as an invariant function. It is shown that it is difficult to determine exactly the conformal length of a given graph, hence the interest of giving good lower and upper bounds of the conformal volume. Lower bounds are derived from the number of edges between the minimal sections of the graph and the number of corners of the minimal section. The upper bound is derived, using a special realization. It is shown that the two bounds are only distinguished by a pi/2 factor. The conformal length is exactly computed for the class of the trees. ESA

N93-21168# Grenoble-1 Univ. (France). Lab. Artemis.
GRAPHS WITH MAXIMUM NUMBER OF MINIMUM CUTS
Jeno Lehel (Hungarian Academy of Sciences, Budapest.), Frederic Maffray (Centre National de la Recherche Scientifique, Grenoble, France.), and Myriam Preissmann (Centre National de la Recherche Scientifique, Grenoble, France.) Apr. 1992 17 p
(Grant MRT/MICECO-058936E12215E)
(RR-880-M; ETN-93-92709) Avail: CASI HC A03/MF A01

The structure of minimum cuts, extremal multigraphs and extremal simple graphs are addressed. The following is considered: let sigma(n,k) be the maximum number of minimum cuts in a k connected multigraph with n vertices. Sigma(n,k) are determined and extremal graphs are characterized for every n and k. The same problem is also investigated for graphs with no multiple edges. ESA

N93-21169# Grenoble-1 Univ. (France). Lab. de Modelisation et Calcul.
THE WEYL METHOD FOR SIMULTANEOUS CALCULATION OF POLYNOMIAL ROOTS (FIRST PART) [LA METHODE DE WEYL POUR LE CALCUL SIMULTANE DES RACINES D'UN POLYNOME (1ERE PARTIE)]
R. Coleman Apr. 1992 26 p In FRENCH
(RR-881-M; ETN-93-92710) Avail: CASI HC A03/MF A01

A Weyl method which applies to all polynomials, requires no approximation, and calculates all the roots simultaneously, is analyzed. The Weyl algorithm is studied theoretically. The algorithm is composed of four steps: polynomial normalization, construction of an epsilon-inclusion, division of S(epsilon) into connected components, and calculation of the number of roots in each connected component of S(epsilon). ESA

N93-21172# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
HEXAGONAL GRID DRAWINGS
Goos Kant Feb. 1992 19 p
(Contract EEC-3075)
(RUU-CS-92-06; ETN-93-92806) Avail: CASI HC A03/MF A01

A linear algorithm to draw triconnected cubic planar graphs planar on a linear sized hexagonal grid such that in at most one edge are bends is presented. This algorithm can be used to draw this class of graphs planar with straight lines on a n/2 by n/2 grid, improving the best known grid bounds by a factor 4. A demonstration of how to draw planar graphs of degree at most 3 planar with straight lines such that the minimum angle is greater than or equal to pi/6 is given. ESA

N93-21174# Technische Hochschule, Darmstadt (Germany). Fachbereich Mathematik.
LOCAL AND GLOBAL PROPERTIES OF CURVE CONGRUENCIES IN EUCLIDEAN THREE DIMENSIONAL SPACE Ph.D. Thesis [LOKALE UND GLOBALE EIGENSCHAFTEN VON KURVEZNKONGRUENZEN IM DREIDIMENSIONALEN EUKLIDISCHEN RAUM]
Udo Mueller 1990 163 p In GERMAN
(ETN-93-93411) Avail: CASI HC A08/MF A02

A computation giving a survey of the invariants of a curve congruency is developed. The geometry of curve congruencies can be described by invariant derivation equations, which lead to geometric determinants. With the necessary integrability conditions, it is shown that a proper selection of determinants is sufficient for the existence of a congruency. Propositions are produced in the classification and existence of striction points and new classes of integral variants. Differential geometry of the immersion of a foliation is dealt with. ESA

N93-21176# Technische Hochschule, Darmstadt (Germany). Fachbereich Informatik.
EFFICIENT IMPLEMENTATION OF A FUNCTIONAL LANGUAGE FOR THE DEFINITION OF PRACTICABLE, DENOTATIONAL SEMANTICS Ph.D. Thesis [EFFIZIENTE IMPLEMENTIERUNG EINER FUNKTIONALEN SPRACHE ZUR DEFINITION AUSFUEHRBARER DENOTATIONALER SEMANTIK]
Rolf Bahlke 1990 145 p In GERMAN
(ETN-93-93413) Avail: CASI HC A07/MF A02

The emphasis is put on an efficient implementation of EVA functional language, which constitutes the basis of semantic definition language. A translation function is derived by a series of transformation steps. The terms of the functional core of EVA are translated into a code for an abstract machine. A series of important optimizations of EVA machines are presented. It is shown that the optimization of required memory selective management of environment entries is developed. Based on the former abstract model of EVA machine, a concrete version is developed which is used as a basis for an implementation of EVA on a real machine. The reference counting method is used as memory management. ESA

N93-21179# Rome Univ. (Italy). Dipt. di Fisica.
A PRELIMINARY STUDY OF THE GRIBOV AMBIGUITY IN LATTICE SU(3) COULOMB GAUGE
C. Parrinello, S. Petrarca, and A. Vladikas 16 Jul. 1991 13 p Submitted for publication Sponsored in part by EEC
(Preprint-816; ETN-93-92922) Avail: CASI HC A03/MF A01

Simulations of pure SU(3) gauge theory on a 1000 by 20 lattice at beta = 6.0 in the Coulomb gauge are reported. From this gauge condition the Gribov ambiguity appears to be maximal, in the sense that the gauge fixing process is highly unstable with respect to variations of the starting configuration via random gauge transformations. A heuristic explanation of the larger number of Gribov copies in such a gauge with respect to the Landau gauge is given. ESA

N93-21180# Rome Univ. (Italy). Dipt. di Fisica.
ON THE ORIGIN OF SL(nC) CURRENT ALGEBRA IN GENERALIZED TWO DIMENSIONAL GRAVITY
K. Yoshida (Istituto Nazionale di Fisica Nucleare, Rome, Italy.) 17 Jul. 1991 24 p Submitted for publication
(Preprint-818; ETN-93-92923) Avail: CASI HC A03/MF A01

The origin of local SL(nC) symmetry in induced gravity in two dimensions, enlarged with so called W fields is considered on higher genus Riemann surface. In the case of W(sub 2) the mathematical structure of Polyakov's two dimensional gravity precisely corresponds to the projective structure of Riemann surfaces. The lack of a consistent generalization of the 'Lagrangian' formulation of two dimensional induced gravity on an arbitrary Riemann surface is underlined. The generalization to higher W(sub n) algebras is presented. ESA

N93-21181# Rome Univ. (Italy). Dipt. di Fisica.
ULTRAMETRICITY IN AN INHOMOGENEOUS SIMPLEST SPIN GLASS MODEL
Silvio Franz (Istituto Nazionale di Fisica Nucleare, Rome, Italy.), Giorgio Parisi (Tor Vergata Univ., Rome, Italy.), and Miguel Angel Virasoro (Istituto Nazionale di Fisica Nucleare, Rome, Italy.) 18 Jul. 1991 6 p Submitted for publication
(Preprint-819; ETN-93-92924) Avail: CASI HC A02/MF A01

The limits of validity of ultrametricity are studied. A system composed of two SK models weakly coupled among themselves is considered. It is assumed that each one of them separately obeys ultrametricity while it is an open question whether the relevant configurations of the total system intended as a whole can be so classified. For zero coupling the answer is trivially negative. For arbitarily small interaction energy, an analysis of the associated generalized random energy models suggests that ultrametricity is recovered. The distribution of the thermodynamical states, in mean field models in inhomogeneous spin glasses, showed that the ultrametric organization of the states is uneffected by inhomogeneity. In the replica formalism, the maximization of the correlations between the states of the two systems is observed. It is possible to introduce an additional interaction term in the replicated hamiltonian so as to decrease this kind of correlation. ESA

N93-21207# Technische Hochschule, Darmstadt (Germany). Fachbereich Mathematik.
UMBILICI, LINES OF CURVATURE, FOCAL SURFACES AND THEIR METAMORPHOSIS Ph.D. Thesis [NABELPUNKTE, KRUEMMUNGSLINIEN, BRENNFLAECHEN UND IHRE METAMORPHOSEN]
Martin Lang 1990 213 p In GERMAN
(ETN-93-93414) Avail: CASI HC A10/MF A03

Fundamental and general statements of surface theory are repsesented. Singular differential equations of the first order are introduced in two variables, as a generalization of approximation differential equations of the curvature line network around umbilici and of other geometrically interesting approximation differential equations. Principles of the invariant theory are caused in the two dimensional and multidimensional differential geometry. A modern introduction to the algebraic invariant theory with differential geometric orientation is presented. Umbilici are examined, using the invariant theory. The generic properties, the generic development/disappearing, and the generic metamorphoses of umbilici are reported. ESA

N93-21242# Naval Postgraduate School, Monterey, CA. Dept. of Mathematics.
DIRECT AND INVERSE UNITARY EIGENPROBLEMS IN SIGNAL PROCESSING: AN OVERVIEW Technical Report, Jul. - Sep. 1992
G. S. Ammar, W. B. Gragg, and L. Reichel 2 Nov. 1992 7 p
(AD-A259348; NPS-MA-93-004) Avail: CASI HC A02/MF A01

A brief review and bibliography related to unitary eigenproblems is

presented. Hessenburg matrices and the Schur parameterization of these matrices, Szego polynomials, and QR algorithms are addressed. GRA

N93-21341# National Oceanic and Atmospheric Administration, Silver Spring, MD. Air Resources Lab.
HYBRID SINGLE-PARTICLE LAGRANGIAN INTEGRATED TRAJECTORIES (HY-SPLIT): VERSION 3.0: USER'S GUIDE AND MODEL DESCRIPTION
Roland R. Draxler Jun. 1992 78 p
(PB92-218114; NOAA-TM-ERL-ARL-195) Avail: CASI HC A05/MF A01

The algorithms and equations used in the calculation of long-range pollutant transport and dispersion are presented from the meteorological data sources through the calculation of air concentrations. The model calculation methods are a hybrid between Eulerian and Lagrangian approaches. A single pollutant particle represents the initial source. Advection and diffusion calculations are made in a Lagrangian framework. As the dispersion of the initial particle spreads it into regions of different wind direction or speed, the single particle is divided into multiple particles to provide a more accurate representation of the complex flow field. Air concentrations are calculated on a fixed three dimensional grid by integrating all particle masses over the sampling time. The model code can be run on a personal computer. GRA

N93-21392# Grenoble-1 Univ. (France). Techniques de l'Informatique, des Mathematiques, de la Microelectronique et de la Microscopie.
THE GENERALIZED VORONOI DIAGRAM FOR A SET OF POLYGONS: ALGORITHMS, OPERATION AND APPLICATIONS TO SHAPE ANALYSIS Ph.D. Thesis [DIAGRAMME DE VORONOI GENERALISE POUR UN ENSEMBLE DE POLYGONES: ALGORITHMES, REALISATION ET APPLICATION EN ANALYSE DE FORMES]
Hai-Tao Hu 1991 201 p In FRENCH
(ETN-93-92689) Avail: CASI HC A10/MF A03

Theoretical and practical problems for the construction of the Generalized Voronoi Diagram (GVD) for a set of polygons are presented. The basis of this work is the construction on multi-scales. In order to construct the GVD of the interior of a polygon, Lee's algorithm, which meets some counterexamples, was modified. The correct condition for terminating a merge process of two subdiagrams based on the concept of visibility between objects is given. For the construction of the GVD of the exterior of a set of polygons, an incrementation algorithm combined with the divide and conquer strategy was implemented. A method to compute a separator in linear time at each step for the incrementation is proposed. This method constitutes the key of this algorithm. To construct a separator efficiently, an algorithm that can simultaneously find the convex hull and the information related to the inclusion of two convex polygons called simple intersection is also proposed. By determining, a priori, the shape and number of continuous branches of a separator, a method of semi-dynamic construction, which updates in linear time a GVD of a set of polygons when a new complex polygon is randomly inserted into the set of polygons, is included. The application of the GVD to pattern analysis is studied. The continuous skeletons of the polygonal patterns are shown to be the inherent features of the GVD. ESA

N93-21395# Grenoble-1 Univ. (France). Lab. de Modelisation et Calcul.
AN ORDER-THEORETIC UNIFICATION AND GENERALISATION OF CERTAIN FUNDAMENTAL BIJECTIONS IN MATHEMATICAL CLASSIFICATION, 2
Frank Critchley and Bernard VanCutsem Jan. 1992 26 p Prepared in cooperation with Warwick Univ.
(RR-875-M; ETN-93-92704) Avail: CASI HC A03/MF A01

A study aimed at showing that a single, simple order-theoretic result unifies and generalizes seven fundamental bijections on mathematical classification is completed. Several characterizations of the ultrametrics within the predissimilarities are obtained in terms of reflexive level foliations. It is shown that the single linkage hierarchical clustering approach can be generalized to nonsymmetric predissimilarities in an arbitary set and taking values in an arbitrary ordered set. Several other applications of the results presented are indicated. ESA

N93-21398# Universiteit Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
THE SHAPLEY VALUE FOR COOPERATIVE GAMES UNDER PRECEDENCE CONSTRAINTS
U. Faigle and W. Kern Jan. 1992 25 p
(MEMO-1025; ETN-93-92453) Avail: CASI HC A03/MF A01

Cooperative games where only those coalitions of players are feasible that respect a given precedence structure on the set of players are considered. Strengthening the classical symmetry axiom, three axioms that give rise to a unique Shapley value in this model are obtained. The Shapley value is seen to reflect the expected marginal contribution of a player to a feasible random coalition, which allows the Shapley value to be evaluated nondeterministically. Every exact algorithm for the Shapley value is shown to require an exponential number of operations already in the classical case and even restriction to simple games is shown to be hash-P-hard in general. The multi choice cooperative games of Hsiao and Raghavan can be treated in this context, which leads to a Shapley value that does not depend on preassigned weights. ESA

N93-21399# Universiteit Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
DETERMINISTIC COMMUNICATION COMPLEXITY OF THE HAMMING DISTANCE
Boris Spieker Jan. 1992 14 p
(MEMO-1026; ETN-93-92454) Avail: CASI HC A03/MF A01

A proof for bounding the deterministic communication complexity of the Hamming distance using recently found results regarding the communication complexity of so called sum type functions and the zeros of Krawtchouk polynomials is presented. An attempt to generalize this to the Hamming distance with alphabet size q greater than 2 is made. ESA

N93-21474# Helsinki Univ. of Technology (Finland). Inst. of Mathematics.
WELL-POSEDNESS AND STABILIZABILITY OF A VISCOELASTIC EQUATION IN ENERGY SPACE Research Report
Olif J. Staffans Jul. 1992 53 p
(PB93-111920; RR-A312; ISBN-951-22-1154-8) Avail: CASI HC A04/MF A01

The authors consider the well-posedness and exponential stabilizability of the abstract Volterra integrodifferential system in a Hilbert space. In a typical viscoelastic interpretation of the equation, one lets upsilon represent velocity, upsilon' represent acceleration, sigma represent stress, -D(sup *) sigma represent the divergence of the stress nu upsilon = or greater than 0 pure viscosity (usually equal to zero), D(upsilon) represent the time derivative of the strain, and alpha represent the linear stress relaxation modulus of the material. The problems that they treat are one-dimensional in the sense that they require alpha to be scalar. First, they prove well-posedness in a new semigroup setting, where the history component of the state space describes the absorbed energy of the system rather than the history of the function upsilon. To get the well-posedness they need, extremely weak assumptions are made on the kernel; it suffices if the system is 'passive', i.e., alpha is of positive type; it may even be a distribution. The system is exponentially stabilizable with a finite dimensional continuous feedback if and only if the essential growth rate of the original system is negative. Under additional assumptions on the kernel they prove that this is indeed the case. The final part of the treatment is based on a new class of kernels. These kernels are of positive type, but they need not be completely monotone. Still, they have many properties similar to those of completely monotone kernels, and a number of results that have been proved earlier for completely monotone kernels can be extended to the new class. GRA

N93-21706# Front Range Scientific Computation, Inc., Denver, CO.
COPPER MOUNTAIN CONFERENCE ON INTERATIVE METHODS, VOLUME 1
1992 378 p Presented at the Copper Mountain Conference on Iterative Methods, Copper Mountain, CO, 9-16 Apr. 1992 Prepared in cooperation with Colorado Univ., Denver, CO
(Contract DE-FG02-91ER-25106)
(DE93-004993; DOE/ER-25106/1-Vol-1; CONF-920472-Vol-1) Avail: CASI HC A17/MF A03

Papers presented at the Copper Mountain Conference on Iterative

Methods held on 9-14 Apr. 1992 are included. Topics covered include: multigrid methods; preconditionings; eigenvalue problems; theory of iterative methods; non-symmetric linear systems; domain decomposition; parallel algorithms; multilevel methods; ill-posed problems; complex and indefinite systems; and colocation matrices. DOE

N93-21963# Oak Ridge National Lab., TN.
PREDICTING STRUCTURE IN NONSYMMETRIC SPARSE MATRIX FACTORIZATIONS
J. R. Gilbert (Xerox Palo Alto Research Center, CA.) and E. G. Ng Oct. 1992 43 p
(Contract DE-AC05-84OR-21400)
(DE93-003365; ORNL/TM-12204) Avail: CASI HC A03/MF A01

Many computations on sparse matrices have a phase that predicts the nonzero structure of the output, followed by a phase that actually performs the numerical computation. We study structure prediction for computations that involve nonsymmetric row and column permutations and nonsymmetric or non-square matrices. Our tools are bipartite graphs, matchings, and alternating paths. Our main new result concerns LU factorization with partial pivoting. We show that if a square matrix A has the strong Hall property (i.e., is fully indecomposable) then an upper bound due to George and Ng on the nonzero structure of L + U is as tight as possible. To show this, we prove a crucial result about alternating paths in strong Hall graphs. The alternating-paths theorem seems to be of independent interest: it can also be used to prove related results about structure prediction for QR factorization. DOE

N93-21966# Los Alamos National Lab., NM.
EXTENSION OF HIGH-RESOLUTION SCHEMES FOR SYSTEMS TO MULTIPLE DIMENSIONS
W. J. Rider 1992 11 p Presented at the AIAA Computational Fluid Dynamics Conference, Orlando, FL, 21-23 Jun. 1992
(Contract W-7405-eng-36)
(DE93-003734; LA-UR-92-3363; CONF-9206313-1) Avail: CASI HC A03/MF A01

The extension of high-resolution schemes from one to two or more dimensions can be accomplished in a number of ways. Several methods for extending one-dimensional Godunov-type schemes to two-dimensional problems are discussed. The different algorithms are described, and results are given for several standard test problems. These tests reveal that standard dimensional splitting has a number of advantages in terms of performance and efficiency. DOE

N93-20657# Alberta Univ., Edmonton. Dept. of Mechanical Engineering.
A METHOD OF CONTINUOUS COORDINATE CONDENSATION
W. F. Eckert and A. Craggs *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 244-245 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20661# Cornell Univ., Ithaca, NY. Sibley School of Mechanical and Aerospace Engineering.
PEANO-LIKE DYNAMICS AS A MODEL FOR STRANGE NONCHAOTIC BEHAVIOUR
M. S. ElNaschie *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 254-255 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

N93-20667# California State Univ., Long Beach. Dept. of Mechanical Engineering.
GREEN'S FUNCTION METHOD FOR VIBRATION OF STRUCTURES
H. V. Vu and J. C. Cule (Northrop Corp., Pico Rivera, CA.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 280-281 (For primary document see N93-20616 07-39)
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N93-20711# McGill Univ., Montreal (Quebec). Dept. of Mechanical Engineering.
THE LINEAR INVARIANTS OF THE COMPOSITION OF TWO ROTATIONS
Jorge Angeles and Murat Tandirci *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 656-657 (For primary document see N93-20616 07-39)
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N93-20712# McGill Univ., Montreal (Quebec). Dept. of Mechanical Engineering.
ON THE FORMULATION OF LINEAR HOMOGENEOUS VELOCITY CONSTRAINTS IN MECHANICAL SYSTEMS
Subir Kumar Saha and Jorge Angeles *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 658-659 (For primary document see N93-20616 07-39)
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N93-20714# Victoria Univ. (British Columbia). Dept. of Mechanical Engineering.
STABILIZATION OF KINEMATICAL CONSTRAINTS FOR OPEN MULTIBODY CHAINS
I. Sharf and Gabriele M. T. DeLeuterio (Toronto Univ., Ontario.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 662-663 (For primary document see N93-20616 07-39)
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N93-20716# Moncton Univ. (New Brunswick).
MODELLING ROBOT TRAJECTORY ERRORS USING TIME SERIES
Roger Boudreau and Edmund Biden (New Brunswick Univ., Fredericton.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 666-667 (For primary document see N93-20616 07-39)
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N93-20719# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
LINEAR PASSIVE IMPEDANCE
Shahram Payandeh and Andrew Goldenberg *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 672-673 (For primary document see N93-20616 07-39)
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N93-20727# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
ON THE NORMALIZED HAMILTONIAN FORMULATION OF THE RESTRICTED THREE-BODY PROBLEM
Ardeshir Guran, Xiaohua Tong, and F. P. J. Rimrott *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 752-753 (For primary document see N93-20616 07-39)
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N93-21522# Vrije Univ., Brussels (Belgium). Analyse van Strukturen.
NUMERICAL FINITE ELEMENT ANALYSIS OF DAMAGE USING MONTE CARLO TECHNIQUES
G. VanVinckenroy and W. P. DeWilde *In* AGARD, Debonding/Delamination of Composites Dec. 1992 6 p Sponsored by Ministry of Economic Affairs; Science Policy Dept. and Belgian National Foundation for Scientific Research (For primary document see N93-21507 07-24)
Copyright Avail: CASI HC A02/MF A03

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N93-20009# Defense Logistics Agency, Alexandria, VA.
OPTIMAL SAMPLING PLANS FOR ITEMS REPRESENTING TWO POPULATION GROUPS Final Report
Randal S. Wendell Apr. 1992 77 p
(AD-A259429; DLA-92-P20041) Avail: CASI HC A05/MF A01

A problem of determining optimal sampling plans is examined. The items to be sampled belong to two distinct populations which are partitioned into sub-populations that require sampling plans. Three mathematical programming models are investigated that minimize the total sample size while also ensuring that the proportion of samples closely resemble the

actual population proportions. Both linear and non-linear programming techniques are used to find an optimal sampling plan. Finally, comparisons are made from the solutions generated by 'real' data for all three models. GRA

N93-20358# Naval Oceanographic and Atmospheric Research Lab., Monterey, CA.

THE DEVELOPMENT OF THE NAVY'S MULTIVARIATE OPTIMUM INTERPOLATION ANALYSIS SYSTEM Final Report

E. H. Barker Jul. 1992 41 p

(AD-A258569; NOARL-44) Avail: CASI HC A03/MF A01

The equations for the Navy's multivariate optimum interpolation (MVOI) analysis system for atmospheric analysis are presented in complete form. Included are the derivations for horizontal and vertical covariances that retain the geostrophic constraint a various kinds of observations such as pressure thickness, pressure height, and winds. Methods that scale the observation values to the resulting nondimensional values so that they are consistent with the constraints are presented. The derivations of the analysis equations are provided using optimal theory to minimize the analysis error variance. The derivation of the internal data checking procedure is given. The method compares suspicious values with neighboring values and removes rejected values in a computationally consistent manner. Validation experiments that show the exactness of the constraints, expected analysis error, and the method for analysis of wind around the poles are presented. These experiments have known results, and therefore are useful in catching design and program errors. A brief description is provided of the observation selection procedures and internal quality control, and some recommendations for improvement are given. GRA

N93-20809# Technische Univ., Delft (Netherlands). Faculty of Mathematics and Informatics.

EXPLICIT PROBABILITIES FOR THE SYMMETRIC COUPLED PROCESSOR

Herman Bavinck, Gerard Hooghiemstra, and Ellen deWaard 1991 13 p

(Rept-91-43; ETN-93-92012) Copyright Avail: CASI HC A03/MF A01

A queuing system, where an exponential server divides his server capacity mu between two separate queues, each queue formed from Poisson arrivals with rate lambda, is studied. The server attends both queues with equal rate, but if one of the queues is empty, full capacity is granted to the other queue. For rho = 2(lambda)/mu less than 1, it is proved that the equilibrium probabilities p(sub n,n) on having n customers in each queue, can be written as p(sub n,n) = (1 - rho)(rho to the power of 2n) summation of a(sub K)(n)(rho to the power of k), where the coefficients a(sub k)(n) are computed explicitly. ESA

N93-20864# Technische Univ., Delft (Netherlands). Faculty of Mathematics and Informatics.

LONG RANGE PERCOLATION IN STATIONARY POINT PROCESSES

Robert M. Burton (Oregon State Univ., Corvallis.) and Ronald W. J. Meester 1991 22 p Sponsored by Netherlands Organization for Applied Scientific Research Research TNO

(Rept-91-54; ETN-93-92016) Copyright Avail: CASI HC A03/MF A01

A continuum percolation model in R(sub d), d greater than or equal to 1, in which any two points of a stationary point process are connected with a probability which decays exponentially in the distance between the points, is considered. Sufficient conditions for the (non)existence of a phase transition are given. Examples of processes which show that it is impossible to write down a theorem which relates the critical parameter value of a process to its density are given. Uniqueness of the infinite cluster is shown to be still valid in this general setting. ESA

N93-20867# Institut National de Recherche d'Informatique et d'Automatique, Le Chesnay (France). Programme 1: Architectures Paralleles, Bases de Donnees, Reseaux et Systemes Distribues.

DENUMERABLE CONSTRAINED MARKOV DECISION PROBLEMS AND FINITE APPROXIMATIONS

Eitan Altman Dec. 1991 32 p

(INRIA-RR-1568; ETN-93-92669) Avail: CASI HC A03/MF A01

The establishment of the theory of discounted constrained Markov decision processes with countable state and action spaces with general multichain structure and the introduction of finite approximation methods are addressed. The occupation measures are defined and properties of the set of all achievable occupation measures under the different admissible policies are obtained. The sufficiency of stationary policies for the constrained control problem is established and a Linear Program (LP) with a countable number of decision variables through which optimal stationary policies are computed is obtained. Since for such an LP an optimal solution in a finite number of operations is not expected, two schemes for finite approximations are presented and their convergence to the required value for both the discounted and the expected average cost is established. ESA

N93-20868# Institut National de Recherche d'Informatique et d'Automatique, Le Chesnay (France). Programme 1: Architectures Paralleles, Bases de Donnees, Reseaux et Systemes Distribues.

THE LINEAR PROGRAM APPROACH IN MARKOV DECISION PROCESSES REVISITED

Eitan Altman and Flos Spieksma (Leiden Univ., Netherlands.) Dec. 1991 20 p

(INRIA-RR-1569; ETN-93-92670) Avail: CASI HC A03/MF A01

Some aspects of linear programs are investigated. Linear programming is known to be an important and useful tool for solving Markov Decision Processes (MDP's). Its derivation relies on the dynamic programming approach, which also serves to solve MDP's. However, for Constrained MDP the only available methods are based on linear programs. A stochastic interpretation of the decision variables that appear in the linear programs available in the literature is presented. It is then shown for the multiconstrained MDP that a (referenced) linear program can be obtained from an equivalent unconstrained Lagrange formulation for the control problem. This shows the connection between the linear program approach and the Lagrange approach, that was previously used only for the case of a single constraint. ESA

N93-20897# Institut National de Recherche d'Informatique et d'Automatique, Le Chesnay (France). Programme 1: Architectures Paralleles, Bases de Donnees, Reseaux et Systemes Distribues.

ESTIMATES OF CYCLE TIMES IN STOCHASTIC PETRI NETS

Francois Baccelli and Panagiotis Konstantopoulos Dec. 1991 22 p

(INRIA-RR-1572; ETN-93-92672) Avail: CASI HC A03/MF A01

The derivation of bounds and estimates for cycle times of strongly connected stochastic event graphs with independent and identically distributed holding times is addressed. Association properties satisfied by partial sums of the holding times are used in order to prove that the firing epochs compare for stochastic ordering with the last birth in a multitype branching process, the structure of which is determined from the characteristics of the event graph using simple algebraic manipulations. Classical large deviation estimates are then used to compute the growth rate of this last birth epoch, following the method of Kingman and Biggins. The method allows a computable upper bound for the cycle time to be described, and is exemplified on tandem queueing networks with communication blocking. ESA

N93-20944# Grenoble-1 Univ. (France). Lab. de Modelisation et Calcul.

A NECESSARY AND SUFFICIENT CONDITION FOR THE EXISTENCE OF THE MAXIMUM LIKELIHOOD ESTIMATE IN AUTOREGRESSIVE MODELS

Serge Degerine Nov. 1991 20 p

(RR-866-M; ETN-93-92698) Avail: CASI HC A03/MF A01

A necessary and sufficient condition for the existence of the Maximum Likelihood Estimate (MLE) in Autoregressive (AR) models is given. It is shown that for almost all sets of n records of length m of complex data, the MLE in AR(p) models exists if and only if the n records can not be exactly fitted by complex sinusoids using the same set of p distinct frequencies. So in estimating AR(p) models with increasing order p, the maximum likelihood method can be applied until p = m - 1 or stops with p just smaller than the minimal number of sinusoids fitting the data exactly. The method working on the reflection coefficients, the discrete spectrum of such sets of sinusoids could be obtained as a borderline case. A second study on local maxima of the likelihood function for Toeplitz matrix estimation is presented. It is demonstrated that in estimating a Toeplitz covariance matrix, the likelihood function can present a local maximum close to the global maximum. An analytical proof is given for the matrices of order 3 and numerical examples are shown for orders 3, 4 and 5. It is shown that when implementing the MLE, it is important to take a good

estimate of the covariance matrix as starting value of the iterative process. ESA

N93-20956# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.
ASYMPTOTIC BEHAVIOUR OF SOME BILINEAR FUNCTIONALS OF THE EMPIRICAL PROCESS
Tadeusz Inglot (Wroclaw Univ., Poland.), Wilbert C. M. Kallenberg, and Teresa Ledwina (Wroclaw Univ., Poland.) Feb. 1992 30 p
(MEMO-1031; ETN-93-9245990) Avail: CASI HC A03/MF A01

For a very large class of bilinear statistics (strong) moderate and large deviation theorems are derived under the null hypothesis, thus extending previous results in this area. The asymptotic distribution is established under the null hypothesis and under alternatives for a wide range of alternatives, in general much wider than the classical range of contiguous alternatives. In the proofs, strong approximation techniques play an important role. ESA

N93-21062# Grenoble-1 Univ. (France). Lab. de Modelisation et Calcul.
ESTIMATION METHODS FOR PARAMETERS OF MULTIVARIATE AUTOREGRESSIVE MODELS Ph.D. Thesis [METHODES D'ESTIMATION DE PARAMETRES DE MODELES AUTOREGRESSIFS MULTIVARIES]
Dinh Quy Tong 1991 163 p In FRENCH
(ETN-93-92685) Avail: CASI HC A08/MF A02

Algorithms for the maximum likelihood method are constructed. Methods and concepts applied in the field of multivariate autoregressive estimations are presented. Algorithmic aspects of the Yule-Walker method, the Burg method, and methods based on partial correlations are considered. Two least means square algorithms, of Dickinson and of Pham, are discussed. Concerning the maximum likelihood method different ways of calculating the log likelihood function are presented; the calculation of the first order derivative and an approximation method for the second order derivative are included. Optimization algorithms for the maximum likelihood method are constructed by using the modified Newton-Raphson iterative method. Results from algorithm simulations and implementation are included. ESA

N93-21191*# Colorado Univ., Boulder. Cooperative Inst. for Research in Environmental Science.
INVERSE SEQUENTIAL DETECTION OF PARAMETER CHANGES IN DEVELOPING TIME SERIES
Uwe Radok and Timothy J. Brown [1992] 9 p
(Grant NAGw-2706)
(NASA-CR-191996; NAS 1.26:191996) Avail: CASI HC A02/MF A01

Progressive values of two probabilities are obtained for parameter estimates derived from an existing set of values and from the same set enlarged by one or more new values, respectively. One probability is that of erroneously preferring the second of these estimates for the existing data ('type 1 error'), while the second probability is that of erroneously accepting their estimates for the enlarged test ('type 2 error'). A more stable combined 'no change' probability which always falls between 0.5 and 0 is derived from the (logarithmic) width of the uncertainty region of an equivalent 'inverted' sequential probability ratio test (SPRT, Wald 1945) in which the error probabilities are calculated rather than prescribed. A parameter change is indicated when the compound probability undergoes a progressive decrease. The test is explicitly formulated and exemplified for Gaussian samples. Author (revised)

N93-21396# Institut National de Recherche d'Informatique et d'Automatique, Le Chesnay (France). Programme 1: Architectures Paralleles, Bases de Donnees, Reseaux et Systemes Distribues.
STOCHASTIC SCHEDULING WITH VARIABLE PROFILE AND PRECEDENCE CONSTRAINTS
Zhen Liu and Eric Sanlaville (Paris VI Univ., France.) Sep. 1991 31 p
(INRIA-RR-1525; ETN-93-92830) Avail: CASI HC A03/MF A01

The stochastic profile scheduling problem of a partially ordered set of tasks on uniform processors is considered. The set of available processors varies in time. The running times of the tasks are independent random variables with exponential distributions. Simple optimal preemptive policies which stochastically minimize the makespan when the partial order is an interval order, or an in-forest, or an out-forest, are obtained. ESA

N93-21736# Los Alamos National Lab., NM.
FLEXIBLE PRIOR MODELS IN BAYESIAN IMAGE ANALYSIS
K. M. Hanson 1992 9 p Presented at the Entropy and Bayesian Workshop, Paris, France, Jul. 1992
(Contract W-7405-eng-36)
(DE93-003728; LA-UR-92-3387; CONF-9207167-1) Avail: CASI HC A02/MF A01

A new class of prior models is proposed for Bayesian image analysis. This class of priors provides an inherent geometrical flexibility, which is achieved through a transformation of the coordinate system of the prior distribution or model into that of the object under analysis. Thus, prior morphological information about the object being reconstructed may be adapted to various degrees to match the available measurements. An example of tomographic reconstruction illustrates the potential of this approach. DOE

N93-21818# National Center for Earthquake Engineering Research, Buffalo, NY.
SIMULATION METHOD FOR STATIONARY GAUSSIAN RANDOM FUNCTIONS BASED ON THE SAMPLING THEOREM
M. Grigoriu and S. Balopoulou 11 Jun. 1992 81 p Sponsored by National Science Foundation, Washington, DC and New York State Science and Technology Foundation, Albany Prepared in cooperation with Cornell Univ., Ithaca, NY
(Grants NSF BCS-90-25010; NEC-91029)
(PB93-127496; NCEER-92-0015) Avail: CASI HC A05/MF A01

A unified method is developed for simulating realizations of real-valued stationary Gaussian processes, vector processes, fields, and vector fields. The method has direct applications to earthquake engineering. Realizations of Gaussian processes and vector processes can be used to model seismic ground accelerations at single and multiple sites. Gaussian random fields can provide representations of the spatial variation of soil properties that need to be considered in earthquake engineering when dealing with systems extending over large areas such as pipeline systems. The proposed method involves parametric random models consisting of superpositions of deterministic functions of time or space with random fields. The proposed simulation method is efficient and uses algorithms for generating realizations of random processes and fields that are similar to simulation techniques based on ARMA models. Several examples are presented to demonstrate the proposed simulation method and evaluate its efficiency and accuracy. GRA

N93-20730# University of Western Ontario, London.
NONLINEARIZATION OF NONLINEAR SYSTEMS UNDER EXTERNAL AND PARAMETRIC RANDOM EXCITATIONS
C. W. S. To *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 758-759 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

No abstracts in this category.

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N93-21178# Rome Univ. (Italy). Dipt. di Fisica.
STUDY OF THE GENERALIZED PARAMETRIC OSCILLATOR
S. Baskoutas (Patras Univ., Greece.), A. Jannussis (Patras Univ., Greece.), and R. Mignani (Istituto Nazionale di Fisica Nucleare, Rome, Italy.) 15

Jul. 1991 8 p Submitted for publication
(Preprint-815; ETN-93-92921) Avail: CASI HC A02/MF A01

The exact solution of the time evolution for the generalized parametric oscillator, both in the Schroedinger and in the Heisenberg representation, is found. The calculation was performed by using the SU(1,1) structure of the Hamiltonian, the isomorphism between the SU(1,1) and SL(2,R) groups and the Wei-Norman expression of the evolution operator. Coherent states and Berry's phase are briefly considered. ESA

N93-21182# Rome Univ. (Italy). Dipt. di Fisica.
TWO-PARAMETER QUANTUM GROUPS
G. Brodimas, A. Jannussis, and R. Mignani (Istituto Nazionale di Fisica Nucleare, Rome, Italy.) 22 Jul. 1991 16 p Submitted for publication
(Preprint-820; ETN-93-92925) Avail: CASI HC A03/MF A01

A deformed Heisenberg-Weyl algebra depending on two parameters, Q and q, is defined. The special case q = 1 corresponds to the Q algebra, while for Q = 1/q the usual q defined algebra is recovered. ESA

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N93-21948# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
LA RECHERCHE AEROSPATIALE BIMONTHLY BULLETIN, NO. 250, MAY - JUNE
Feb. 1990 67 p
(ONERA-1989-3; ESA-TT-1205) Avail: CASI HC A04/MF A01

Topics covered include: (1) airfoil noise in a uniform flow; (2) structure and microtexture of silicon carbide fibers; (3) computation of the thin-layer Navier-Stokes equations for a 2-D flow; (4) numerical simulation of turbulence in a 2-D channel flow; and (5) periodical wavelet analysis, a tool for inhomogeneous field investigation. Author

N93-21957# Oak Ridge National Lab., TN.
INTEGRATING REAL-TIME DIGITAL SIGNAL PROCESSING CAPABILITY INTO A LARGE RESEARCH AND DEVELOPMENT FACILITY
W. W. Manges, J. T. Mallinak-Glassell, J. E. Breeding, J. M. Jansen, Jr., R. M. Tate, and R. R. Bentz 1992 29 p Presented at the International Conference on Signal Processing Applications and Technology, Boston, MA, 5 Nov. 1992
(Contract DE-AC05-84OR-21400)
(DE93-003085; CONF-9211118-1) Avail: CASI HC A03/MF A01

The Instrumentation and Controls Division at Oak Ridge National Laboratory recently developed and installed a large scale, real-time measurement system for the world's largest pressurized water tunnel. This water tunnel, the Large Cavitation Channel (LCC) provides a research and development facility for the study of acoustic phenomena to aid in model testing of new naval ship and submarine designs. The LCC design required the development of a near-field beamformer in addition to extending the range of real-time processing capability to frequencies unavailable at other facilities. The beamformer acquires and processes time-domain acoustic data at 9.5 MB/s from up to 45 hydrophones while performing 200 million floating-point operations per second, producing a time-integrated, spatially filtered, frequency-domain data set with improved signal-to-noise ratio. The acoustic processing software provides for the real-time analysis of acoustic data. Up to 128 facility sensors are sampled, time stamped, and stored at 600 kB/s. The system generates information for acoustic phenomena and facility measurements in real-time so that the operator can make facility adjustments to control the running equipment. This real-time control of facility conditions requires that the measurement system integrate facility and acoustic data for simultaneous display to the operator in engineering units via high-end workstations. A dual-host minicomputer configuration with high-end workstations connected via an Ethernet networking cluster controls and integrates measurement and display subsystems. The hardware and software architecture is described in this paper. DOE

71 ACOUSTICS

Includes sound generation, transmission and attenuation.
For noise pollution see *45 Environmental Pollution.*

N93-20885# Max-Planck-Inst. fuer Stroemungsforschung, Goettingen (Germany).
EXPERIMENTAL INVESTIGATIONS ON CONVERGING SECOND-SOUND SHOCK WAVES IN He 2 [EXPERIMENTELLE UNTERSUCHUNGEN AN KONVERGIERENDEN SECOND-SOUND-STOSSWELLEN IN HE II]
Georg Stamm 1991 83 p In GERMAN
(MPIS-103/1991; ETN-93-92591) Avail: CASI HC A05/MF A01

The propagation of converging second sound shock waves is investigated in a counterflow channel of appropriate geometry. A method to measure both the spatial and the temporal evolution of the temperature and the local vortex line density field produced by the shock front of a heating pulse is described. The pulse repetition rate is between 0.2 and 0.5 s, and the distance from the heated surface can be adjusted from 1 to 40 mm. When comparing the experiments with numerical simulations, it is shown that a drift velocity of the same direction and of the same order of magnitude as the counterflow velocity, is to be assumed. ESA

N93-21024# Max-Planck-Inst. fuer Stroemungsforschung, Goettingen (Germany).
EXPERIMENT AND MODELING OF THE NOISE REDUCTION FOR A TURBULENT SUPERSONIC JET BY MEANS OF A NOZZLE WITH A SUDDEN ENLARGEMENT Thesis [EXPERIMENT UND MODELLIERUNG ZUR MINDERUNG DER SCHALLEMISSION VON TURBULENTEN UEBERSCHALLFREISTRAHLEN MITTELS EINER DUESE MIT QUERSCHNITTSSPRUNG]
Andreas Menne Dec. 1991 84 p In GERMAN
(MPIS-15/1991; ETN-93-92592) Avail: CASI HC A05/MF A01

Noise reduction is accomplished by using a convergent nozzle having a sudden enlargement behind the narrowest cross sectional area. The observed noise reduction is due to the decrease in the flow velocity behind the shock and the absence of further shock waves. A further expansion of the subsonic flow was achieved by using a short diffuser behind the sudden enlargment. The configuration yields a maximum noise reduction of 30 dB as compared with the noise of a free jet emerging from a convergent nozzle. Based on the Borda Carnot relation and on the modeling of the throat as a cylindrical or a spherical source, a gas dynamical evaluation of the flow quantities and the nozzle parameters was performed which allowed calculations with regard to the minimal noise emission. ESA

N93-21249# Department of the Navy, Washington, DC.
EMBEDDED FIBER OPTIC ACOUSTIC SENSORS Patent Application
Nicholas Lagkas, inventor (to Navy) 20 Aug. 1992 41 p
(AD-D015568; US-Patent-Appl-SN-932685; Navy-Case-74303) Avail: CASI HC A03/MF A01

A interferometric planar and linear fiber optic sensor system comprised of a sensor element and a reference element. In the planar fiber optic sensor system the sensor and reference fibers are shaped in loops circularly and uniformly, heat treated or bonded together and embedded in a spiral pattern within a low Bulk Modulus and Young's Modulus elastomer encapsulant. The invention results in high and frequency independent sensitivity which minimizes acceleration effects. For the linear sensor, the sensing fiber is shaped in loops forming a linear chain which is embedded in an appropriate low bulk modulus elastomeric encapsulant. The reference fiber is shaped in loops around a cylindrical aluminum mandrel within which the input and output fiber cables and couplers are encapsulated in a high bulk modulus material epoxy resin. In both the planar and linear forms, the sensing and reference fiber may be of equal length, however, the reference fiber may be of a shorter length when a coherent light source is utilized. GRA

N93-21317*# Georgia Inst. of Tech., Atlanta.
EFFECT OF PERSONAL AND SITUATIONAL VARIABLES ON NOISE ANNOYANCE: WITH SPECIAL REFERENCE TO IMPLICATIONS FOR EN ROUTE NOISE Final Report
James M. Fields Aug. 1992 243 p Sponsored in part by FAA

(Contract NAS1-19061)
(NASA-CR-189676; NAS 1.26:189676; DOT/FAA/EE-92/03) Avail: CASI HC A11/MF A03

Over 680 publications from 282 social surveys of residents' reactions to environmental noise have been examined to locate 495 published findings on 26 topics concerning non-noise explanations for residents' reactions to environmental noise. This report (1) tabulates the evidence on the 26 response topics, (2) identifies the 495 findings, and (3) discusses the implications for en route noise assessment. After controlling for noise level, over half of the social survey evidence indicates that noise annoyance is not strongly affected by any of the nine demographic variables examined (age, sex, social status, income, education, homeownership, type of dwelling, length of residence, or receipt of benefits from the noise source), but is positively associated with each of the five attitudinal variables examined (a fear of danger from the noise source, a sensitivity towards noise generally, the belief that the authorities can control the noise, the awareness of non-noise impacts of the source, and the belief that the noise source is not important). Author

N93-21368# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (Germany). Abt. Technische Akustik.
CALCULATION OF NOISE EMISSION CAUSED BY JET AIRCRAFT DURING TAKEOFF, APPROACH AND HORIZONTAL FLYOVER [BERECHNUNG DER LAERMIMMISSION DURCH STRAHLFLUGZEUGE BEI START, LANDUNG UND HORIZONTALFLUG]
Jan Boettcher and Ulf Michel Oct. 1991 43 p In GERMAN
(DLR-Mitt-91-15; ETN-93-91916) Avail: CASI HC A03/MF A01; DLR, Wissenschaftliches Berichtswesen, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Germany, HC

A prediction scheme for jet noise is applied for noise calculations. The results are discussed for the neighborhood of an airfield for which sound emission is shown in the form of contour plots. The noise reduction potential achievable by varying operational parameters is demonstrated and quantified. The variation of takeoff and landing procedures, the decrease of aircraft weight and flight Mach number, and the increase of the flight altitude are shown to possibly result in a partially substantial noise reduction. ESA

N93-20679# National Inst. of Standards and Technology, Boulder, CO.
EXPERIMENT AND MODELING OF AIR-COUPLED ULTRASONIC EXCITATION OF PLATE WAVES
C. M. Fortunko, M. C. Renken, R. L. Bratton (Colorado Univ., Boulder.), and S. K. Datta (Colorado Univ., Boulder.) *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 364-365 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N93-20023# EG and G Energy Measurements, Inc., Santa Barbara, CA. Special Technologies Lab.
A REVIEW OF THE ASSOCIATED PARTICLE IMAGING TECHNIQUE
J. P. Hurley, A. Beyerle, R. Durkee, G. Headley, and L. Tunnell 1992 7 p Presented at the 12th International Conference on the Application of Accelerators in Research and Industry, Denton, TX, 2-5 Nov. 1992
(Contract DE-AC08-88NV-10617)
(DE93-002238; EGG-10617-3017; CONF-921116-6) Avail: CASI HC A02/MF A01

Associated particle imaging (API) is a fast-neutron reaction imaging system. An object is illuminated with 14-MeV neutrons and these neutron interaction sites are imaged. The T(d,n)(sup 4)He reaction is used to produce a neutron and an alpha particle which move apart in opposite directions. By detecting the alpha particle, the direction of travel of the neutron is known. When the neutron strikes any material (except hydrogen and helium) it causes the material to emit gamma radiation. If one of the gamma-rays is detected it is then known that a reaction has taken place. By measuring the time between alpha detection and gamma detection, it is known how long the neutron traveled before reacting. By constructing a tally (or histogram) of these reaction sites an image is constructed. By examining the gamma-ray spectra corresponding to each region of space, elemental analysis of that region can be performed. This technique and it's applications are discussed. DOE

N93-20385# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Physics.
STUDY OF ELECTROWEAK INTERACTIONS Progress Report
1991 40 p
(Contract DE-AS05-80ER-10713)
(DE93-004367; DOE/ER-10713/T3) Avail: CASI HC A03/MF A01

This document is a technical progress report for research conducted at Virginia Tech under DOE contract of 'Study of Electron-Positron Interactions' DE-AS05-80ER10713, Task B, during the past year. The report is divided into three main sections, dealing with the three primary activities of the group: the AMY experiment at TRISTAN (hardware upgrade, inclusive and isolated photon production, study of Bhabha scattering, electron substructure, and extra Z bosons, production of Lambda(sup 0) and Lambda(sup 0), and QED and search for pair production of massive photinos), the MEAGER/RHO experiment at LAMPF (planning and data acquisition for the decays mu(sup +) yields e+ gamma and mu+ yields e+nu(sub e)(anti nu)(sub mu)), and an r and d program on resistive plate chamber development at Virginia Tech. DOE

N93-20604# Naval Research Lab., Washington, DC.
SURVEY OF NUCLEAR ACTIVATIONS FOR INTENSE PROTON AND DEUTERON BEAMS Interim Report
Frank C. Young and David V. Rose 24 Dec. 1992 48 p
(Contract DE-AC04-76DP-00789)
(AD-A259258; NRL/MR/6770-92-7155; NRL/MR/6670-92-7155) Avail: CASI HC A03/MF A01

Proton- and deuteron-induced nuclear reactions which produce radioactivities are surveyed for application to experiments with intense ion beams from pulsed power generators. Positive Q-value reactions with up to 10-MeV protons or deuterons on carbon, aluminum, titanium-alloy, steel, and brass targets are identified. For each radioactivity, the half-life and decay products are tabulated. Measured cross sections from the published literature are used to identify reaction yields. For protons, thick-target yields are evaluated for (p,n) reactions on these targets. For deuterons, thick-target yields are evaluated for several (d,n), (d,p), and (d,a) reactions on these targets. GRA

N93-20802 Department of the Navy, Washington, DC.
OPTICAL TRACKING OF CHARGED PARTICLE BEAMS Patent
Irving L. Kofsky, inventor (to Navy) and Christian A. Trowbridge, inventor (to Navy) 29 Sep. 1992 4 p Filed 1 Apr. 1991
(AD-D015592; US-Patent-5,151,746; US-Patent-Appl-SN-677899) Avail: US Patent and Trademark Office

Radiated images of the propagation path of a charged particle beam simultaneously projected to spaced points on a platform, are recorded by path tracking video cameras. Data on the positional orientation of the path tracking cameras during reception of simultaneously projected images, measured by inertial sensors is utilized to calculate the location and direction of the beam propagation path by iterative triangulation. GRA

N93-20850# Rome Univ. (Italy). Dipt. di Fisica.
INCLUSIVE BEAUTY DECAYS AND THE SPECTATOR MODEL
G. Altarelli and S. Petrarca 27 Feb. 1991 18 p Submitted for publication
(Preprint-790; ETN-93-92900) Avail: CASI HC A03/MF A01

A complete updated analysis of the branching ratios of inclusive b decays in a pure parton picture with inert spectator light quark(s) is presented. Recent data indicate a small value for the average semileptonic decay fraction. Particular attention is devoted to evaluating the central value and the range of theoretical error for this quantity. It shows that, while the data is consistent with the spectator model, there are indications for a moderate non spectator contribution. These terms are discussed and the ratio tau(minus)/tau(neutral) is suggested to be around its present upper limit. ESA

N93-20875# Technische Univ., Berlin (Germany). Fachbereich Physik.
HIGH FREQUENCY SPECTROSCOPY FOR COLLISION EXCITED HELIUM ATOM FINE STRUCTURE OF 1s4f CONFIGURATION Ph.D. Thesis [HOCHFREQUENZSPEKTROSCOPIE AN STOSSANGEREGTEN HELIUMATOMEN FEINSTRUKTUR DER 1S4F-KONFIGURATION]
Hans Walter Schilling 1992 93 p In GERMAN
(ETN-93-92560) Avail: CASI HC A05/MF A01

Excited helium atoms with n = 4.5 and l equal to or greater than 2 were examined using the methods of high frequency spectroscopy of an ionic collision apparatus. The 1s4f multiplet is the energetically deepest fine structure multiplet of the helium atom. The great polarizabilities of the excited helium structures allowed induction of electric to quantum dipole transitions between structures of equal parity. The induction of high frequency transitions developed a change in the intensity of collision lighting. The measured energy dissociation and the calculated exchange integral are in very good agreement with values calculated using a variational method.
ESA

N93-20883# Technische Univ., Berlin (Germany). Fachbereich Physik.
PHOTOIONIZATION EXPERIMENTS BY MULTISTAGE EXCITATION IN THE ZONE OF THE SECOND IONIZATION THRESHOLD OF CuI Ph.D. Thesis [PHOTOIONISATIONSEXPERIMENTE DURCH MEHRSTUFENANREGUNG IM BEREICH DER ZWEITEN IONISATIONSSCHWELLE VON CuI]
Michael Martins 1992 121 p In GERMAN Sponsored by DFG
(ETN-93-92569) Avail: CASI HC A06/MF A02

The conditions of the first double excited configuration of CuI were measured, and interference effects of these conditions were examined with Rydberg series. A multistage excitation was used in order to reach the zone of the second ionization threshold with laser spectroscopic methods. Atomic copper is vaporized in an atomic beam oven in which a burning gas discharge in the oven simultaneously induces a collision excitation in the metastable state of CuI. Photoionization spectra are calculated using the results obtained from Hartree-Fock computations. The measured Rydberg conditions are analyzed using quantum defect theory. ESA

N93-20905# Rome Univ. (Italy). Dipt. di Fisica.
SEMI-LEPTONIC DECAYS OF D-MESONS IN LATTICE QCD
V. Lubicz (Istituto Nazionale di Fisica Nucleare, Rome, Italy.), G. Martinelli (Istituto Nazionale di Fisica Nucleare, Rome, Italy.), M. S. McCarthy (Southampton Univ., England.), and C. T. Sachrajda (Southampton Univ., England.) 2 Jul. 1991 16 p Submitted for publication
(Preprint-808; SHEP-90/91-27; ETN-93-92917) Avail: CASI HC A03/MF A01

The results of a lattice calculation of D-meson semileptonic decays into pseudoscalar and vector particles are presented. With respect to previous studies of D decays to K, polarized K, pi, and rho, the statistis could be doubled, and the SU(3) breaking effects on the relevant form factors were studied. The Zweig allowed contributions to the form factors and the corresponding partial rates for the semileptonic decays of D and D(sub S) into phi, omega, eta and eta' mesons were predicted. The lattice results for the form factor which govern semileptonic decays into pi and K mesons are in good agreement with experimental results. ESA

N93-20923# Rome Univ. (Italy). Dipt. di Fisica.
MIXING AND CP-VIOLATION IN K AND B-MESONS: A LATTICE QCD POINT OF VIEW
Maurizio Lusignoli (Istituto Nazionale di Fisica Nucleare, Rome, Italy.), Luciano Maiani (Istituto Nazionale di Fisica Nucleare, Rome, Italy.), Guido Martinelli (Istituto Nazionale di Fisica Nucleare, Rome, Italy.), and Laura Reina (SISSA, Trieste, Italy.) 3 Jul. 1991 36 p Revised Submitted for publication
(Preprint-810; ETN-93-92918) Avail: CASI HC A03/MF A01

The neutral K-antineutral K and neutral B-antineutral B mixing is analyzed on the basis of experimental results and theoretical lattice determination of the relevant matrix elements. A top mass larger than 140 GeV and f(sub B) equal or greater than 200 MeV is found. These results suggest a Charge conjugation and Space inversion (CP) violating asymmetry in B decays to J/psi + K(sub S) much larger than previously estimated. The corresponding theoretical prediction for epsilon'/epsilon for which rather large experimental and theoretical uncertainties still exist is reported. The basic definitions and formulae for the calculation of epsilon, R(sub d) and epsilon(prime) are given. The determination of the real angles from semileptonic data is discussed. The calculation of the Wilson coefficients is illustrated. Short distance Quantum Chromodynamics (QCD) corrections are evaluated. The B parameters, from lattice calculations, are presented.
ESA

N93-20924# Rome Univ. (Italy). Dipt. di Fisica.
TWO LOOP CALCULATION OF THE ANOMALOUS DIMENSION OF THE AXIAL CURRENT WITH STATIC HEAVY QUARKS
V. Gimenez 5 Jul. 1991 44 p Sponsored by Spanish Ministerio de Education y Ciercia; Submitted for publication
(Preprint-813; ETN-93-92919) Avail: CASI HC A03/MF A01

A method to perform two loop calculations in Eichten's effective field theory for heavy quarks is developed. The anomalous dimension of the axial current for static heavy quarks is calculated at two loops. For N = 3, (gamma(sub A))(sup 2) = -1/36(127/2 + 94(xi)2 - 5N(sub f)). The result is very important to understand the physical significance of the lattice measurement of the decay constant of the B meson. The two loop correction generated by the second coefficient of (gamma(sub A))(sup 2) turns out to be small, less than 1.5 percent for four quark flavors, so that the value of the decay constant of the B meson does not need in practice renormalization group improvement. The self energy renormalization constant at two loop level for a heavy static quark and that for the coupling of a heavy quark to a gluon are obtained. ESA

N93-21209# Technische Hochschule, Darmstadt (Germany). Fachbereich Physik.
DEVELOPMENT AND UTILIZATION OF A SEMI-ANALYTIC ALTERNATIVE CHARGE PROCESS FOR THE RAPID CALCULATION OF POTENTIAL DISTRIBUTIONS AND ELECTRON ORBITS Ph.D. Thesis [ENTWICKLUNG UND ANWENDUNG EINES SEMI-ANALYTISCHEN ERSATZLADUNGSVERFAHRENS ZUR SCHNELLEN BERECHNUNG VON POTENTIALVERTEILUNGEN UND ELEKTRONENBAHNEN]
Gerald Schoenecker 1989 98 p In GERMAN
(ETN-93-93416) Avail: CASI HC A05/MF A02

Rapid processes were developed for the computation of potential distributions and electron orbits in present electrode arrangements. The knowledge of electron orbits in these fields allowed fast and accurate determination of the electron optical properties of the arrangement. An alternative to the mesh process was used, according to which the analytically given potentials of simple charge distributions were so superposed that the boundary conditions, for example the potentials on the electrode surfaces, were reproduced. The potential and the electric field were analytically given in each spatial point. The developed alternative charge process allowed the solution of two dimensional and simple not rotationally symmetric three dimensional problems. Utilization examples were given.
ESA

N93-21480# Argonne National Lab., IL. High Energy Physics Div.
THE ELECTROMAGNETIC CALORIMETER FOR THE STAR EXPERIMENT AT RHIC
D. G. Underwood 1992 4 p Presented at the 3rd International Conference on Calorimetry in High Energy Physics, Corpus Christi, TX, 29 Sep. - 2 Oct. 1992
(Contract W-31-109-eng-38)
(DE93-002780; ANL-HEP-CP-92-95; CONF-9209263-3) Avail: CASI HC A01/MF A01

The STAR detector at the Relativistic Heavy Ion Collider (RHIC) can be used both for searches for quark-gluon plasma and for high energy pp spin physics. An electromagnetic calorimeter is being planned which will be used for triggering on high pt direct gammas, e(+ or -), and the electromagnetic component of jets. Jets will be measured for both kinds of physics by using the electro-magnetic calorimeter and central TPC tracking. Some features of the fiber-tile calorimeter as it is presently being designed is described. DOE

N93-21481# Virginia Univ., Charlottesville. Dept. of Physics.
NUCLEAR STUDIES WITH INTERMEDIATE ENERGY PROBES
B. E. Norum 10 Jul. 1992 28 p
(Contract DE-FG05-87ER-40364)
(DE93-002785; DOE/ER-40364/T1) Avail: CASI HC A03/MF A01

Data from measurements at NIKHEF-K of the electro-production of

neutral pions from the proton were completely analyzed and are about to be submitted for publication. These results represent the first precise measurement of this fundamental process in the threshold region. The results are completely consistent with calculations based upon the Low Energy Theorems. Results from studies of a gas jet target in the electron storage ring of the Saskatchewan Accelerator Laboratory (SAL) have been fully analyzed and are being prepared for publication. An Internal Target Development Facility (ITDF), established at NIKHEF-K in a collaborative effort for the purpose of developing higher density gas jet targets suitable for use in electron rings, is operational. Diagnostic techniques are being evaluated in preparation for evaluating jet technology options. Our study of the calcium isotopes C-42 and C-44 is nearing completion. Both the electron and proton scattering data were completely analyzed. Consistent proton and neutron transition densities were extracted, and are being compared to corresponding results from pion scattering. Preparations for (gamma, pi(-)) measurements at SAL were completed, and data taking is about to commence. DOE

N93-21703# Brookhaven National Lab., Upton, NY. Alternating Gradient Synchrotron Dept.

RADIATION FROM MOVING CHARGED PARTICLES WITH SPIN

A. Luccio Oct. 1992 24 p

(Contract DE-AC02-76CH-00016)

(DE93-004633; BNL-52348; AGS/AD-93-1) Avail: CASI HC A03/MF A01

The theory of radiation emitted by a charged particle with spin in relativistic motion in an external magnetic field is reviewed. Approximate expressions suitable for numerical computation, in far and near field, are derived. In particular, the case of the passage of a particle accelerator beam through an undulator is considered. It is shown that observation of the spectrum of the emitted radiation, in its two states of polarization, can be used not only for beam diagnostics, but also to measure the spin state of the accelerated particles. Undulator radiation is compared with Compton scattering of laser light by the particle beam. Examples for high energy electron and proton colliders are presented. DOE

N93-21705# Yale Univ., New Haven, CT.

EXPERIMENTAL NUCLEAR PHYSICS

1992 51 p

(Contract DE-FG02-91ER-40609)

(DE93-004950; DOE/ER-40609/2) Avail: CASI HC A04/MF A01

An earlier study of unusual electromagnetic decays in (sup 86)Zr was extended in order to make comparisons with its isotone (sup 84)Sr and with (sup 84)Zr. The K=14 (t(sub 1/2) = 70 ns) high-spin isomer in (sup 176)W was found to have a 13 percent branch directly to the K=O ground-state band, one of the strongest violations of K-selection rules known. A new program to search for a predicted region of oblate deformation involving neutron deficient isotopes in the Rn/Fr/Ra region was begun. In the area of nuclear astrophysics, as part of a study of the onset of the rp-Process, a set of measurements searching for possible new resonances for (sup 14)O+(alpha) and (sup 17)F+p reactions was completed and a coincidence experiment measuring the (sup 19)F ((sup 3)He,t) (sup 19)Ne(alpha) (sup 15)O and (sup 19)F ((sup 3)He,t) (sup 19)Ne(p) (sup 18)F reactions in order to determine the rates of the (sup 18)F(p,(alpha)) (sup 15)O and (sup 18)F(p,(gamma)) (sup 19)Ne reactions was begun. Experimental measurements of (beta)n(alpha) coincidences from the (sup 15)N(d,p) (sup 16)N((beta)- (nu)) (sup 16)O((alpha)) (sup 12)C reaction have also been completed and are currently being analyzed to determine the rate of the (sup 12)C((alpha),(gamma)) reaction. In the APEX collaboration, we have completed the assembly and testing of two position-sensitive Na barrels which surround the axial silicon detector arrays and serve as the e(sup +) triggers by detecting their back-to-back annihilation quanta were completed. The HI@AGS and RHIC collaborations, construction and implementation activities associated with the space-time-tracker detector and in the design of the central detector for the PHENIX experiment were carried out. Operation of the ESTU tandem accelerator has been reliable, delivering beam on target at terminal voltages as high as 19.3 MV and running for as long as 143 days between tank openings. Fabrication and bench testing of a new negative ion source system have been completed. DOE

N93-21707# Toledo Univ., OH. Dept. of Physics and Astronomy.

SEMIEMPIRICAL STUDIES OF ATOMIC STRUCTURE

L. J. Curtis 1992 3 p

(Contract DE-FG05-88ER-13958)

(DE93-005117; DOE/ER-13958/30) Avail: CASI HC A01/MF A01

The energy level structure, transition probabilities, and general spectroscopic properties of highly ionized many-electron systems are studied through the combined use of sensitive semiempirical data systematizations, selected precision experimental measurements, and specialized theoretical computations. Measurements are made primarily through the use of fast ion beam excitation methods, which are combined with available data from laser and tokamak produced plasmas, astrophysical sources, and conventional light sources. The experimental studies are strengthened through large-scale ab initio calculations. Typical examples are the following: lifetime measurements in the neon isoelectronic sequence; multiplexed decay curve measurements of Li-like Si 12; and isoelectronic specification of intershell resonance and intercombination decay rates using measured transition probabilities and spectroscopically determined singlet-mixing amplitudes. DOE

N93-21718# Stanford Research Inst., Menlo Park, CA.

THE DISCOVERY OF THE TAU LEPTON

M. L. Perl Sep. 1992 15 p Presented at the 3rd International Symposium on the History of Particle Physics, the Rise of the Standard Model, Stanford, CA, 24-27 Jun. 1992

(Contract DE-AC03-76SF-00515)

(DE93-004013; SU-SLAC-PUB-5937; CONF-9206131-3) Avail: CASI HC A03/MF A01

The discovery of the tau lepton and the third generation of fermions came from the convergence of three physics streams in the late 1960's and early 1970's. These streams were: the failed attempts by myself and others to understand the connection between the electron and the muon; the development of electron-positron storage rings; and the development of the theory of sequential leptons. I give the history of the discovery of the tau and the measurement of its major properties - the properties which established the tau as a sequential lepton. DOE

N93-21720# Argonne National Lab., IL.

NON-EQUILIBRIUM STRUCTURES INDUCED BY ION IRRADIATION IN Ni4Mo

P. Bellon (Commissariat a l'Energie Atomique, Saclay, France.), P. R. Okamoto, and G. Schumacher (Hahn-Meitner-Inst. G.m.b.H., Berlin, Germany.) Nov. 1992 17 p Presented at the 3rd Conference on Evolution of Microstructure in Metals during Irradiation, Minett, Ontario, 29 Sep - 2 Oct. 1992

(Contract W-31-109-eng-38)

(DE93-004193; ANL/MSD/CP-78010; CONF-920970-5) Avail: CASI HC A03/MF A01

We have studied the stability of equilibrium and metastable ordered phases (called LRO and SRO respectively) in Ni4Mo during 500-keV Ne or 250-keV He irradiations. Some irradiations were performed in situ, allowing thus to follow the evolution of the samples, which were characterized by Transmission Electron Microscopy. Dynamical equilibrium phase diagrams are built, by varying the irradiation flux, temperature and dose. At a fixed ion flux, there exists a temperature range where a 'mixed' ordered state is stabilized, and remains stable up to the maximum doses reached (1.7 dpa). This state, which cannot be obtained by electron irradiation, consists in the coexistence of the two ordered phases at a very fine scale (less than or = 2nm). Comparison with results already reported after electron irradiation is made, stressing the role played by displacement cascades in our results. Furthermore we observed alignment of dislocation loops along, the (001) c-axis of the quadratic LRO phase. DOE

N93-21723# Stanford Research Inst., Menlo Park, CA.

ASPECTS OF THE ELECTROWEAK PHASE TRANSITION

P. Huet Nov. 1992 3 p Presented at the Meeting of the Division of Particles and Fields of the American Physics Society, Batavia, IL, 10-14 Nov. 1992

(Contract DE-AC03-76SF-00515)

(DE93-004629; SU-SLAC-PUB-5999; CONF-921122-6) Avail: CASI HC A01/MF A01

The electroweak phase transition is reviewed in light of some recent

developments. Emphasis is on the issue whether the transition is first or second order and its possible role in the generation of the baryon asymmetry of the universe. DOE

N93-21739# Los Alamos National Lab., NM.
NUMERICAL VALIDATION OF A CONSTITUTIVE THEORY FOR AN ARBITRARILY FRACTURED SOLID
B. C. Trent and L. G. Margolin 1992 12 p Presented at the International Conference on Discrete Element Methods, Cambridge, MA, 17-18 Mar. 1993
(Contract W-7405-eng-36)
(DE93-003863; LA-UR-92-3917; CONF-930365-2) Avail: CASI HC A03/MF A01

We have developed a general constitutive theory that estimates the effective elastic moduli of a cemented granular material by applying statistical mechanical averaging to a purely micromechanical model. We have also constructed a distinct element model of a cemented granular material, based on the same micromechanical model, which accounts for the elastic forces due to bonding between pairs of spherical particles, and which allows for the possibility of anisotropic damage to the bonds. In this paper, we use a model based on the distinct element method (DEM) to validate the predictions of the theory for various prescribed patterns of damage. In particular, we impose several anisotropic patterns of damage on the bonds of a randomly generated assembly of particles. We then do numerical experiments, sending both p-waves and s-waves through the samples and measuring the wave velocities. The predictions of the theory for these velocities agree well with the results of the numerical model for a variety of damage patterns. We discuss the implications of our theory as well as potential applications. DOE

N93-21740# Oak Ridge National Lab., TN.
EFFECT OF QUARK-GLUON PLASMA BOUNDARY ON THE MOMENTUM DISTRIBUTION OF QUARKS
Cheuk-Yin Wong 1992 5 p Presented at the 22nd International Symposium on Multiparticle Dynamics, Santiago de Compostela, Spain, 13-17 Jul. 1992
(Contract DE-AC05-84OR-21400)
(DE93-004166; CONF-9207169-1) Avail: CASI HC A01/MF A01

The boundary of a quark-gluon plasma affects the momentum distribution of quarks in the plasma. In particular, a transverse boundary leads to a transverse momentum distribution with a shape different from the thermal distribution especially in the high transverse momentum region. Consequently, boundary effect must be taken into account if one wishes to estimate the magnitudes of signals in a search for the quark-gluon plasma. DOE

N93-21742# Oak Ridge National Lab., TN.
TOWARDS A TIME-DEPENDENT DESCRIPTION OF ELECTRON-ATOM/ION COLLISIONS: TWO ELECTRON SYSTEMS
C. Bottcher, D. H. Madison, and D. R. Schultz 1992 19 p Presented at the Future Direction in Electron-Ion Collision Physics, Atlanta, GA, 9-10 Apr. 1992
(Contract DE-AC05-84OR-21400)
(DE93-004531; CONF-9204186-1) Avail: CASI HC A03/MF A01

This report contains the following discussions on a time-dependent description of electron-atom/ion collisions: numerical calculation of correlated wavefunctions for the coulomb three-body problem; the basis-spline collocation method; and time-dependent perturbation theory model. DOE

N93-21751# Oak Ridge National Lab., TN.
ANGULAR DISTRIBUTIONS OF CHARGE EXCHANGE COLLISIONS AT VERY LOW ENERGIES
N. Keller (Tennessee Univ., Knoxville.), R. D. Miller (Tennessee Univ., Knoxville.), M. Westerlind (Tennessee Univ., Knoxville.), L. R. Andersson (Tennessee Univ., Knoxville.), S. B. Elston (Tennessee Univ., Knoxville.), I. A. Sellin (Tennessee Univ., Knoxville.), and C. Biedermann (Manne Siegbahn Inst. of Physics, Stockholm, Sweden.) 1992 12 p Presented at the 12th International Conference on the Application of Accelerators in Research and Industry, Denton, TX, 2-5 Nov. 1992
(Contract DE-AC05-84OR-21400)
(DE93-002338; CONF-921116-4) Avail: CASI HC A03/MF A01

We have measured angular distributions of double-electron capture in C(4+) yields He collisions at energies between 400 and 800 eV. The experimental energy-gain spectra show that the ground state of C(2+) (1s(sup 2) 2s(sup 2)) is populated. In the angular distributions we observe an interference pattern which is attributed to Stueckelberg oscillations. We find additional structures in the spectra that are not related to the Stueckelberg interferences. The presented results are compared to experimental data as well as theoretical calculations by other authors. DOE

N93-21828# National Inst. of Standards and Technology, Gaithersburg, MD. Ionizing Radiation Div.
POLARIZATION EFFECTS IN COHERENT AND INCOHERENT PHOTON SCATTERING: SURVEY OF MEASUREMENTS AND THEORY RELEVANT TO RADIATION TRANSPORT CALCULATIONS
John H. Hubbell Jul. 1992 34 p
(PB93-126092; NISTIR-4881) Avail: CASI HC A03/MF A01

The report reviews available information on polarization effects arising when photons in the x-ray and gamma-ray energy regime undergo coherent (Rayleigh) scattering and incoherent (Compton) scattering by atomic electrons. In addition to descriptions and discussions of these effects, including estimates of their magnitudes as they apply to radiation transport calculations, an annotated bibliography 1905-1991 of 102 selected works is provided, with particularly relevant works for the purpose of the report flagged with asterisks. A major resource for the report is a 1948 unpublished informal report by L.V. Spencer which will be quoted here almost in its entirety, since, of all the works cited in the annotated bibliography, it appears to be the only one which explicitly and directly addresses the purpose of the report, hence the valuable material should be re-introduced into the available and current literature. GRA

N93-21846# Ames Lab., IA.
STABLE CLUSTERS IN THE CONDENSED STATE AND SOME POSSIBILITIES FOR GAS PHASE CLUSTERS
J. D. Corbett and S. C. Sevov 17 Sep. 1992 5 p Presented at the 6th International Symposium on Small Particles and Inorganic Clusters, Chicago, IL, 16-22 Sep. 1992
(Contract W-7405-eng-82)
(DE93-004446; IS-M-721; CONF-920921-7) Avail: CASI HC A01/MF A01

The classical naked cluster ions of the post-transition elements that are stable in solid compounds and their lower charged analogues observed in mixed metal beams reflect the reduced number of good bonding orbitals. New cluster ions of indium that are hypoelectronic (fewer than 2n + 2 skeletal bonding electrons) because of distortions or the bonding of heterometal atoms within the clusters are described. A large family of new, orbital-rich clusters of the group 3 and 4 transition metals sheathed by halide are all centered by a wide variety of heteroatoms. Factors in their stability, possible analogous naked cluster targets, and some calculations are considered. DOE

N93-21851# Pacific Northwest Lab., Richland, WA.
DIFFERENTIAL ELECTRON EMISSION IN MULTI-CHARGED ION ATOM COLLISIONS: SYSTEMATICS FOR DISTANT AND CLOSE COLLISIONS
R. D. DuBois, L. H. Toburen, M. E. Middendorf, and O. Jagutzki (Johann-Wolfgang-Goethe-Univ., Frankfurt am Main, Germany.) Sep. 1992 6 p Presented at the 6th International Conference on Physics of Highly Charged Ions, Manhattan, KS, 28 Sep. - 2 Oct. 1992
(Contract DE-AC06-76RL-01830)
(DE93-004324; PNL-SA-21302; CONF-920948-11) Avail: CASI HC A02/MF A01

Absolute doubly differential cross sections for electron emission are presented for 0.5 MeV/u multi-charged ion impact on helium, neon, and argon targets. For the helium target, B(q+), C(q+) (q = 2-5) and O(q+), F(q+) (q = 3-6) projectiles were studied; for neon and argon, only C(q+) (q = 2-5) projectiles were used. Electron emission for 10 deg is less than or equal to theta is less than or equal to 60 deg was studied. The measured cross sections were assumed to scale as the square of an effective projectile charge, Z(sub eff), which was determined as a function of emitted electron energy and angle. For distant collisions (low emitted electron energies), Z(sub eff) is approximately q for small q and Z(sub eff) less than q for the highest values of q investigated. For sufficiently close collisions (above the binary encounter peak), Z(sub eff) is greater than Z

and increases as q decreases. This is true for all angles and targets investigated. DOE

N93-21854# Fermi National Accelerator Lab., Batavia, IL.
MULTI-JET PRODUCTION RATES IN DEEP-INELASTIC MUON-PROTON SCATTERING
C. W. Salgado Oct. 1992 8 p Presented at the ICHEP-26: Twenty-Sixth International Union of Pure and Applied Physics Conference on High Energy Physics, Dallas, TX, 6-12 Aug. 1992
(Contract DE-AC02-76CH-03000)
(DE93-004410; FNAL/C-92/262; CONF-920837-25) Avail: CASI HC A02/MF A01

Measurements of forward multi-jet production rates in deep-inelastic muon-proton scattering are presented. Data were taken with a 490 GeV muon beam incident on a hydrogen target. Jets were defined using the JADE jet finding algorithm. The measured rates are presented as functions of W, the hadronic center-of-mass energy and the jet resolution parameter, y(sub cut), in energies up to W = 33 GeV. Good agreement is found in comparisons with predictions of the QCD-inspired Lund Monte Carlo models. Non-perturbative QCD production mechanisms, inside the Lund Model, can not reproduce the results for energies greater than W approximately equal to 20 GeV. Sensitivities of the jet rate measurements to the low x (x approximately equal to 0.02) gluon content of the nucleon and the evolution of (alpha)(sub s), are studied. DOE

N93-21954# Lawrence Livermore National Lab., CA.
ELECTRON IMPACT IONIZATION OF HIGHLY CHARGED LITHIUMLIKE IONS Ph.D. Thesis
D. A. Vogel Aug. 1992 290 p
(Contract W-7405-eng-48)
(DE93-002895; UCRL-LR-111710) Avail: CASI HC A13/MF A03

Inner-shell ionization of highly-charged lithiumlike ions by electron collision is observed, and the cross section for ionization at different energies is observed. Two elements, chromium and iron, were selected for the investigation. The two elements are close together in the periodic table, with atomic numbers of Z = 24 and Z = 26, respectively. In the lithiumlike state, all of their electrons except the last three have been removed, leaving a highly-charged positive ion with the atomic configuration 1s(sup 2)2sD(sup 2)S(sub 1/2). Removal of an inner-shell electron, that is, a 1s electron, from these highly-charged ions requires a relatively large energy transfer from the colliding electron, 7350 eV for Cr(21+) and 8685 eV for Fe(23+). The process leaves the ion in an excited heliumlike configuration, 1s2s, and the excited ions can decay radiatively to the heliumlike ground state, producing observable x rays. It is these decay x rays that provide the means of detecting the ionization events and measuring the impact ionization cross section. DOE

N93-21968# Los Alamos National Lab., NM.
NEUTRON-PROTON BREMSSTRAHLUNG EXPERIMENTS
J. E. Koster, R. O. Nelson, M. E. Schillaci, S. A. Wender, D. Mayo, F. P. Brady, J. Romero, D. Krofcheck, M. Blann, and P. Anthony et al 1992 8 p Presented at the 12th International Conference on the Application of Accelerators in Research and Industry, Denton, TX, 2-5 Nov. 1992
(Contract W-7405-eng-36)
(DE93-003737; LA-UR-92-3334; CONF-921116-16) Avail: CASI HC A02/MF A01

It is well known that charged particles emit bremsstrahlung radiation when they are accelerated. Classical electron bremsstrahlung occurs when a photon is emitted by an electron accelerated in the field of a nucleus. The bremsstrahlung process also occurs in the scattering of nucleons, for which it is the lowest energy inelastic process that can occur. Like electron bremsstrahlung, nucleon-nucleon bremsstrahlung also requires the exchange of a virtual particle to conserve energy and momentum. In electron bremsstrahlung a virtual photon is exchanged but with two nucleons a meson can be exchanged. Unlike electron bremsstrahlung, in nucleon-nucleon bremsstrahlung the photon can originate from the exchanged meson. This exchange contribution has been shown in calculations to be a significant fraction of bremsstrahlung events. Thus bremsstrahlung serves as a probe of exchange currents in the nucleon-nucleon interaction. Because of a lack of a free neutron target or an intense neutron beam, few measurements of neutron-proton bremsstrahlung exist, each having poor statistical accuracy and poor energy resolution. The white neutron source at the Weapons Neutron Research (WNR) target area at the Los Alamos Meson Physics Facility (LAMPF) produces neutrons with energies from below 50 to above 400 MeV. Using time-of-flight techniques and a liquid hydrogen target, we are measuring the outgoing photons of energies up to 250 MeV at gamma ray angles of around 90 deg relative to the incident beam. Protons scattered at very forward angles are also detected in coincidence with the gamma rays. DOE

N93-21991# Brookhaven National Lab., Upton, NY.
MONTE CARLO STUDIES OF POSITRON IMPLANTATION IN ELEMENTAL METALLIC AND MULTILAYER SYSTEMS
V. J. Ghosh, D. O. Welch, and K. G. Lynn 1992 11 p Presented at the 5th International Workshop on Slow-Positron Beam Techniques for Solids and Surfaces, Jackson, WY, 6-10 Aug. 1992
(Contract DE-AC02-76CH-00016)
(DE93-003474; BNL-47979; CONF-920829-1) Avail: CASI HC A03/MF A01

We have used a Monte Carlo computer code developed at Brookhaven to study the implantation profiles of 1-10 keV positrons incident on a wide range of semi-infinite metals and multilayer systems. Our Monte Carlo program accounts for elastic scattering as well as inelastic scattering from core and valence electrons, and includes the excitation of plasmons. The implantation profiles of positrons in many metals as well as Pd/Al, and Al/Co/Si multilayers are presented. Scaling relations and closed-form expressions representing the implantation profiles are also discussed. DOE

N93-21998# Los Alamos National Lab., NM.
SOLUTIONS FOR IMPLEMENTING TIME-OF-FLIGHT TECHNIQUES IN LOW-ANGLE NEUTRON SCATTERING, AS REALIZED ON THE LOW-Q DIFFRACTOMETER AT LOS ALAMOS
R. P. Hjelm, Jr. and P. A. Seeger 1992 13 p Presented at the International Seminar on Structural Investigation at Pulsed Neutron Sources, Dubna, Russia, 1-4 Sep. 1992
(Contract W-7405-eng-36)
(DE93-003702; LA-UR-92-3271; CONF-9209225-2) Avail: CASI HC A03/MF A01

The implementation of small-angle (Low-momentum transfer) neutron scattering at pulsed spallation sources, using time of flight methods, has meant the introduction of some new ideas in instrument design, data acquisition, data reduction and computer management of the experiment and the data. Here we recount some of the salient aspects of solutions for implementing time of flight small-angle neutron scattering instruments at pulsed sources, as realized on the Low-Q Diffractometer, LQD, at Los Alamos. We consider, further, some of the problems that are yet to be solved, and take a short excursion into the future of SANS instrumentation at pulsed sources. DOE

N93-20814*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
RECOMMENDED PRACTICES FOR IN-SPACE AND GROUND LABORATORY. ATOMIC OXYGEN EXPOSURE AND ANALYSIS
Bruce Banks, Steve Koontz, Matt McCargo, Gary Pippin, and Sharon Rutledge *In* Canadian Space Agency, Protection of Materials and Surface Finishes from the Low Earth Orbit Space Environment 1992 27 p
(For primary document see N93-20810 07-25)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3, HC

N93-21081# Winnipeg Univ. (Manitoba).
DEFECT CHARACTERIZATION BY MEANS OF POSITRON ANNIHILATION
S. Dannefaer, T. Bretagnon, and D. Kerr *In* Canadian Space Agency, Spacebound 1991 1991 p 53-58 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory. For space radiation see *93 Space Radiation.*

N93-20880# Technische Univ., Berlin (Germany). Fachbereich Physik.
EXPERIMENTAL INVESTIGATIONS OF UNDULATOR RADIATION COMPATABILITY Ph.D. Thesis [EXPERIMENTELLE UNTERSUCHUNGEN ZUR BERECHENBARKEIT VON UNDULATORSTRAHLUNG]
Karl Molter 1992 148 p In GERMAN
(ETN-93-92566) Avail: CASI HC A07/MF A02

For the development of a calculable radiation source prototype of intensive variable frequency monochromatic radiation, the efficiency of the compatibility of undulator radiation was examined by comparison of measured and calculated radiation intensity of various installed undulators in the BESSY storage ring. A compact pinhole transmission grill spectrometer was developed and characterized for the experimental determination of undulator radiation intensity in the spectral field of 50 up to 500 eV. A radiometric comparison was carried out between the calculable BESSY and two short undulators with 6.5 to 7.5 periods and a 35 period undulator. The results of the investigations showed that an undulator with a great number of periods is particularly suitable for radiometric applications, with regard to spectral purity, low bandwidth, and high radiation intensity. ESA

N93-21177# Rome Univ. (Italy). Dipt. di Fisica.
ANOMALOUS WWZ COUPLINGS AT FUTURE E(+)E(-) COLLIDERS
S. Ambrosanio and B. Mele (Istituto Nazionale di Fisica Nucleare, Rome, Italy.) 30 Jul. 1991 40 p Submitted for publication
(Preprint-814; ETN-93-92920) Avail: CASI HC A03/MF A01

The effects of possible charge conjugation and space inversion conserving anomalous couplings in the trilinear gauge vertex WWZ in the process positron-electron decay to Z neutral-nu-nu bar are studied. Total cross sections and distributions for various square root of S are computed versus the anomalous eta(sub Z) and lambda(sub Z) couplings by means of the analytic expression for the invariant differential cross section. An explicit expression for sigma is given at different square root of S. Limits on eta(sub Z) and lambda(sub Z) that can be put at future positron-electron colliders on the basis of the reaction positron-electron decay to Z neutral-nu-nu(bar) are discussed. A table of coefficients which allow to calculate cross sections for any value of WWZ couplings is given. Various distributions in the neutral boson kinematical variables are included. ESA

N93-21206# Technische Hochschule, Darmstadt (Germany). Fachbereich Physik.
CONSTRUCTION OF A CHANNELING RADIATION SOURCE AND PRODUCTION OF INTENSIVE CHANNELING RADIATION AT THE DARMSTADT (GERMANY) SUPERCONDUCTIVE ELECTRON ACCELERATOR Ph.D. Thesis [AUFBAU EINER CHANNELINGSTRAHLUNGSQUELLE UND ERZEUGUNG INTENSIVER CHANNELINGSTRAHLUNG AM SUPRALEITENDEN DARMSTAEDTER ELEKTRONENBESCHLEUNIGER]
Wilfried Lotz 1990 117 p In GERMAN
(ETN-93-93410) Avail: CASI HC A06/MF A02

The apparatus designed and constructed for the production and the measurement of channeling radiation at a new superconductive electron accelerator is described. Channeling radiation induced by electrons in silicon single crystals and diamond was detected. The line positions of the considered graduations were considered and compared with theoretical models. An experimental investigation for the development of a quasi monochromatic, continuously variable radiation source of high brilliancy was represented. High electronic currents used, result in photon intensities per second, of up to six orders of magnitude, with regard to intensities reached to date. ESA

N93-21729# Lawrence Livermore National Lab., CA.
RELATIVISTIC SHOCK WAVES AND THE EXCITATION OF PLERIONS
J. Arons (California Univ., Berkeley.), Y. A. Gallant (California Univ., Berkeley.), A. B. Langdon, and T.-Y. B. Yang 17 Jul. 1992 14 p Presented at the Physics of Isolated Pulsars Workshop, Taos, NM, 23-28 Feb. 1992 Revised
(Contract W-7405-eng-48)
(DE93-003469; UCRL-JC-105642-Rev-1; CONF-9202117-7-Rev-1) Avail: CASI HC A03/MF A01

In relativistic shocks, the mechanisms of high energy particle acceleration and of basic thermalization can be one and the same -- accelerating relativistic particles can be part of the problem of shock structure itself. In fact, the highest energy electrons and positrons in the shock theory we outline below are those which have Larmor radii comparable to the gyro-radii of the heavy ions which control the shock thickness, and are precisely the e(plus minus) which give rise to the highest energy synchrotron photons observed in the nebular spectrum. Thus, the problems of shock structure and of nonthermal particle acceleration are one and the same. DOE

N93-21979# Argonne National Lab., IL.
APPLICATION OF RADIOFREQUENCY SUPERCONDUCTIVITY TO ACCELERATORS FOR HIGH-CURRENT ION BEAMS
J. R. Delayen, C. L. Bohn, W. L. Kennedy, C. T. Roche, and L. Sagalovsky 1992 17 p Presented at the 13th National Particle Accelerator Conference, Dubna, Russia, 13-15 Oct. 1992
(Contract W-31-109-eng-38)
(DE93-002925; ANL/EP/CP-77608; CONF-9210224-1) Avail: CASI HC A03/MF A01

A development program is underway to apply rf superconductivity to the design of continuous-wave (cw) linear accelerators for high-current, high-brightness ion beams. During the last few years, considerable progress has been made both experimentally and theoretically toward this application. Recent tests of niobium resonators for ion acceleration have yielded average accelerating gradients as high as 18 MV/m. In an experiment with a radio-frequency quadrupole geometry, niobium was found to sustain cw peak surface electric fields as high as 128 MV/m over large (10 cm) surface areas. Theoretical studies of beam halo, cumulative beam breakup, and alternating-phase focusing have also yielded important results. This paper summarizes the recent progress and identifies current and future work in the areas of superconducting accelerator technology for high-current ion beams. DOE

74 OPTICS

Includes light phenomena; and optical devices. For lasers see *36 Lasers and Masers.*

N93-20022# Lawrence Livermore National Lab., CA.
HIGH-BANDWIDTH, HIGH-DYNAMIC-RANGE, ANALOG OPTICAL GUIDED-WAVE SYSTEMS FOR PHYSICS INSTRUMENTATION
M. Lowry, R. Haigh, K. Hugenberg, D. Masquelier, C. McConaghy, K. McCammon, D. Nelson, and F. Roeske Jul. 1992 5 p Presented at the Broadband Analog and Digital Opto-Electronics, Santa Barbara, CA, 29-31 Jul. 1992
(Contract W-7405-eng-48)
(DE93-001619; UCRL-JC-110847; CONF-9207162-1) Avail: CASI HC A01/MF A01

Two remote measurement systems that efficiently exploit the information transmission capacity of optical guided-wave technology are developed. The first system, which operates at 820 nm, was developed for nuclear weapons measurements and emphasizes high-bandwidth high-dynamic range information transmission. The second system was developed for the detector readout at the Super-Conducting Super Collider (SSC); this system emphasizes high charge sensitivity measurement transmission and operates at 1320 nm. Most of the component design (including modeling), fabrication, packaging, characterization, and system integration was done at Lawrence Livermore National Laboratory (LLNL) specifically for these specialized physics measurements applications. DOE

N93-20126# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
GEOMETRY AND PHOTOMETRY IN 3D VISUAL RECOGNITION
Amnon Shashua Nov. 1992 177 p
(Contract N00014-91-J-4038; NSF IRI-89-00267)
(AD-A259443; AI-TR-1401) Avail: CASI HC A09/MF A02

This thesis addresses the problem of visual recognition under two sources of variability: geometric and photometric. The geometric deals with

the relation between 3D objects and their views under parallel, perspective, and central projection. The photometric deals with the relation between 3D matte objects and their images under changing illumination conditions. Taken together, an alignment-based method is presented for recognizing objects viewed from arbitrary viewing positions and illuminated by arbitrary settings of light sources. In the first part of the thesis we show that a relative non-metric structure invariant that holds under both parallel and central projection models can be defined relative to four points in space and, moreover, can be uniquely recovered from two views regardless of whether one or the other was created by means of parallel or central projection. As a result, we propose a method that is useful for purposes of recognition (via alignment) and structure from motion, and that has the following properties: (1) the transition between projection models is natural and transparent, (2) camera calibration is not required, and (3) structure is defined relative to the object and does not involve the center of projection. GRA

N93-20285 Cornell Univ., Ithaca, NY.
BIREFRINGENT POLARIZATION RAY TRACING: THEORY AND APPLICATIONS Ph.D. Thesis
Stephen Charles McClain 1992 263 p
Avail: Univ. Microfilms Order No. DA9300803

Birefringent polarization ray tracing is an extension of geometric ray tracing. In addition to calculating ray paths and phases, it also analyzes the state of polarization through birefringent devices. Some systems containing birefringent elements include optical computers, radiometers, optical isolators, bar code scanners, and optical data storage systems. This dissertation derives explicit algorithms for polarization ray tracing through anisotropic media, optically active media, and anisotropic optically active media, such as quartz. The objective was to go beyond the electromagnetic relations to establish algorithms in standard ray tracing format, ready for direct inclusion into lens design software. The algorithms, derived from Maxwell's equations, constitutive relations, and boundary conditions, calculate the wavevector, ray vector, optical path length, refractive index, and polarization state of a ray. Generalized Fresnel relations govern the division of energy at each interface into two transmitted and two reflected modes. The algorithms are applied to calculate the polarization aberrations of a variety of birefringent devices. In particular, it is established that the polarization properties of quartz vary significantly (greater than 20 percent) over angles of only 5 degrees. This limits the useful field of view of quartz devices. Field of view aberrations of birefringent elements can critically affect the performance of optical systems. Also, design guidelines are presented for pseudodepolarizers. These devices spatially scramble the polarization. Inserted into an instrument, a depolarizer negates the polarization sensitivity of the elements which follow it. Presented in detail is the design and analysis of a depolarizer for use in a spectrometer on NASA's Earth Observing System (EOS). Dissert. Abstr.

N93-20316*# Alabama Univ., Birmingham. Dept. of Physics.
DESIGN AND ANALYSIS OF A FAST, TWO-MIRROR SOFT-X-RAY MICROSCOPE Final Report, 12 Aug. 1991 - 11 Aug. 1992
D. L. Shealy, C. Wang, W. Jiang, L. Jin, and R. B. Hoover (National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.) 11 Sep. 1992 12 p Presented at SPIE Conference 1741-05, San Diego, CA, 19-24 Jul. 1992
(NASA Order H-08073-D)
(NASA-CR-191440; NAS 1.26:191440) Avail: CASI HC A03/MF A01

During the past several years, a number of investigators have addressed the design, analysis, fabrication, and testing of spherical Schwarzschild microscopes for soft-x-ray applications using multilayer coatings. Some of these systems have demonstrated diffraction limited resolution for small numerical apertures. Rigorously aplanatic, two-aspherical mirror Head microscopes can provide near diffraction limited resolution for very large numerical apertures. The relationships between the numerical aperture, mirror radii and diameters, magnifications, and total system length for Schwarzschild microscope configurations are summarized. Also, an analysis of the characteristics of the Head-Schwarzschild surfaces will be reported. The numerical surface data predicted by the Head equations were fit by a variety of functions and analyzed by conventional optical design codes. Efforts have been made to determine whether current optical substrate and multilayer coating technologies will permit construction of a very fast Head microscope which can provide resolution approaching that of the wavelength of the incident radiation. Author (revised)

N93-20372# Riverside Research Inst., New York, NY.
TREND FIELD TEST REPORT
23 Nov. 1992 56 p
(Contract N00014-91-C-0015)
(AD-A258568; RRI-TR-1/C68-603B) Avail: CASI HC A04/MF A01

This report describes work carried out, leading up to and including the final ground based field test of the Testbed for Realistic Evaluation of Novel Discriminants (TREND) electro-optical system. The ultimate goal of this system is to provide a means of passive discrimination between moving objects and a stationary cluttered background by virtue of signal source angular velocity separation. Angular velocity may be inferred by signal frequency on a single periodically masked detector as the source moves across its field of view. The signal amplitude must vary sufficiently over an angular subtense equal to half the mask period to register above the local noise. Such signals may arise from point objects (with respect to half the mask period) or hard edges perpendicular to the mask period. An additional twist to this method, utilized in the TREND sensor, optically filters selected spatial frequencies by dividing the wavefront at the aperture, transmitting radiation through a double slit. GRA

N93-20397# Department of the Navy, Washington, DC.
METHOD AND APPARATUS FOR CONTROLLING INTERNAL ROTATION OF PRINCIPAL AXES IN FABRICATION OF BIREFRINGENT FIBERS Patent Application
Charles G. Askins, inventor (to Navy) and M. J. Marrone, inventor (to Navy) 29 Jun. 1992 17 p
(AD-D015611; US-Patent-Appl-SN-906093; Navy-Case-70230) Avail: CASI HC A03/MF A01

A technique and apparatus for detecting the internal rotation of the principal axes in the fabrication of birefringent fibers is based upon a new method for producing and interpreting the interference fringe pattern backscattered power from a birefringent fiber side-illuminated with a laser light source to determine the internal orientation of the strain-inducing axes. An apparatus employing this technique for controlling internal rotation of the principal axes provides for adjustment of the orientation of at least one of the traction surfaces pulling the fiber during drawing fabrication to maintain parallel alignment of the planes of rotation of the surfaces to reduce the fiber rotation-inducing motion which leads to internal rotation of the fibers principal axes. GRA

N93-20731*# Bauer Associates, Wellesley, MA. Electro-Optical Systems.
DEVELOPMENT OF A MEASUREMENT OF UPPER MID FREQUENCY ERRORS ON ARBITRARY GRAZING INCIDENCE OPTICS Final Report, Oct. 1988 - Oct. 1990
Paul Glenn 5 Dec. 1990 96 p
(Contract NAS5-30311)
(NASA-CR-191333; NAS 1.26:191333) Avail: CASI HC A05/MF A01

Two state-of-the-art subsystems (detection and servo) were developed and performance generally more than an order of magnitude better than comparable commercial subsystems was achieved. Most importantly, though, the breadboard instrument measured more than an order of magnitude more accurately than the original 1 Angstrom goal within the primary spatial period range. Extensive measurements were taken, and a useful set of Phase 3 modifications were defined. Author (revised)

N93-20797 Department of the Navy, Washington, DC.
INTERFEROMETRIC OPTICAL FIBER DATA LINK Patent
Donald J. Albares, inventor (to Navy) 18 Aug. 1992 6 p Filed 2 May 1985
(AD-D015581; US-Patent-5,140,636; US-Patent-Appl-SN-789046) Avail: US Patent and Trademark Office

An apparatus for a method for assuring the secure transmission of information between a transmitter and a receiver is fabricated along the lines of a Mach-Zehnder interferometer. Two, identical length single-mode fibers extend between the transmitter and receiver to act as transmission paths. Within the transmitter a coiled length of like single-mode fiber integrally extends from one of the fibers reaching from the transmitter to the receiver. Within the receiver a like length of like singlemode fiber integrally extends

from the other end of the other fiber reaching from the transmitter to the receiver. A superradiant diode in the transmitter emits pulses of coherent wavetrains that are split and sent through the two lengths of fibers and their associated integrally connected coils. GRA

N93-20898# Institut National Polytechnique, Grenoble (France). Lab. d'Informatique Fondamentale et d'Intelligence Artificielle.
AUTOMATIC MODELING OF NONPOLYHEDRAL OBJECTS BY MONOCULAR OBSERVATION Ph.D. Thesis [MODELISATION AUTOMATIQUE D'OBJETS NON POLYEDRIQUES PAR OBSERVATION MONOCULAIRE]
Emmanuel Arbogast 1991 146 p In FRENCH Sponsored by EEC
(ETN-93-92678) Avail: CASI HC A07/MF A02

A method to analyze nonpolyhedral moving scenes by monocular vision technique is investigated. Special attention is given to the differential geometry and to the space-time surface on the surface reconstruction by using image boundary data. The problem of evaluating the camera's own motion from fixed boundaries observations is discussed. The reconstruction model is presented. Curves and surfaces are reconstructed from moving image data. By the analysis of the boundaries from several images, the reconstruction of either a three dimensional boundary or its surface is possible. This technique requires an accurate description of the camera's motion. Such differential methods require an accurate data smoothing and subpixel accuracy. The B splines supply all these requirements. Synthetic and real examples illustrate the technique's feasibility. ESA

N93-21245# University of Central Florida, Orlando. Center for Research In Electro-Optics and Lasers.
NONLINEAR FIBER OPTICS Final Technical Report, 1 Nov. 1990 - 1 Nov. 1992
George Stegeman 8 Dec. 1992 18 p
(Grant AF-AFOSR-0086-91)
(AD-A259363; AFOSR-93-0005TR) Avail: CASI HC A03/MF A01

Nonlinear interactions in fibers, primarily for applications to all-optical switching devices, have been investigated. (1) The theory of all-optical switching with gain in erbium-doped dual core fibers has been developed. (2) Several and various experiments were performed in nonlinear fiber rocking filters. (3) A femtosecond infrared (1650 nm) source has been built. (4) An APM color center laser (300 fsec - 1 psec pulse width) has been constructed. (5) A new mechanism for soliton compression has been demonstrated. (6) A dual frequency, CW color center laser has been constructed. (7) The periodic evolution into dark solitons of a pulsed two color source has been demonstrated. (8) Photoinduced gratings in Ge doped sol-gel films have been demonstrated. (9) Nonlinear fiber-optic experiments in tapered fibers have been attempted. GRA

N93-21248# Department of the Navy, Washington, DC.
OPTICAL WAVEGUIDES BY ION EXCHANGE Patent Application
Jasbinder Sanghera, inventor (to Navy), Pablo Pureza, inventor (to Navy), and Ishwar D. Aggarwal, inventor (to Navy) 1 Sep. 1992 27 p
(AD-D015564; US-Patent-Appl-SN-937765; Navy-Case-73863) Avail: CASI HC A03/MF A01

This invention pertains to optical waveguides which includes waveguides of all shapes and sizes, preforms, and optical fibers made from the preforms, and to a method for making waveguides devoid of a physical interface. The method includes preparation of a waveguide from a halide-containing glass, heating the waveguide to a temperature below crystallization temperature of the glass so that it is still solid, providing a gaseous reactive medium containing halide ions of higher electronegativity than halide ions in the waveguide, exposing the waveguide to said reactive medium for a sufficient duration for the halide ions of higher electronegativity in the reactive medium to replace at least a portion of the halide ions of lower electronegativity in the waveguide, and cooling the waveguide whereby a lower refractive index is formed on the side of the waveguide exposed to the reactive medium than the refractive index internally of the waveguide so that light can travel through the portion of the waveguide having the higher refractive index. GRA

N93-21263# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
TOWARDS AUTONOMOUS MOTION VISION
M. A. Taalebinezhaad Apr. 1992 20 p
(Contract N00014-85-K-0124)
(AD-A259339; AI-M-1334) Avail: CASI HC A03/MF A01

Earlier, we introduced a direct method called fixation for the recovery of shape and motion in the general case. The method uses neither feature correspondence nor optical flow. Instead, it directly employs the spatiotemporal gradients of image brightnesses. This work reports the experimental results of applying some of our fixation algorithms to a sequence of real images where the motion is a combination of translation and rotation. These results show that parameters such as the fixation patch size have crucial effects on the estimation of some motion parameters. Some of the critical issues involved in the implementation of our autonomous motion vision system are also discussed here. Among those are the criteria for automatic choice of an optimum size for the fixation patch, and an appropriate location for the fixation point which results in good estimates for important motion parameters. Finally, a calibration method is described for identifying the real location of the rotation axis in imaging systems. GRA

N93-21363*# Massachusetts Inst. of Tech., Cambridge. Dept. of Materials Science and Engineering.
GROWTH AND CHARACTERIZATION OF BINARY AND PSEUDO-BINARY 3-5 COMPOUNDS EXHIBITING NON-LINEAR OPTICAL BEHAVIOR. UNDERGRADUATE RESEARCH OPPORTUNITIES IN MICROGRAVITY SCIENCE AND TECHNOLOGY Annual Report, period ending 30 Nov. 1991
August F. Witt Feb. 1992 20 p
(Grant NAGw-1563)
(NASA-CR-192143; NAS 1.26:192143) Avail: CASI HC A03/MF A01

In line with the specified objectives, a Bridgman-type growth configuration in which unavoidable end effects - conventionally leading to growth interface relocation - are compensated by commensurate input-power changes is developed; the growth rate on a microscale is predictable and unaffected by changes in heat transfer conditions. To permit quantitative characterization of the growth furnace cavity (hot-zone), a 3-D thermal field mapping technique, based on the thermal image, is being tested for temperatures up to 1100 C. Computational NIR absorption analysis was modified to now permit characterization of semi-insulating single crystals. Work on growth and characterization of bismuth-silicate was initiated. Growth of BSO ($B_{12}SiO_{20}$) for seed material by the Czochralski technique is currently in progress. Undergraduate research currently in progress includes: ground based measurements of the wetting behavior (contact angles) of semiconductor melts on substrates consisting of potential confinement materials for solidification experiments in a reduced gravity environment. Hardware modifications required for execution of the wetting experiments in a KC-135 facility are developed. Author

N93-21505# National Inst. of Standards and Technology, Boulder, CO.
TECHNICAL DIGEST-SYMPOSIUM ON OPTICAL FIBER MEASUREMENTS, 1992
G. W. Day, ed. and D. L. Franzen, ed. Sep. 1992 249 p Symposium held in Boulder, CO, 15-17 Sep. 1992 Prepared in cooperation with Lasers and Electro-Optics Society (IEEE), Piscataway, NJ
(PB93-102259; NIST/SP-839) Avail: CASI HC A11/MF A03

The digest contains summaries of 54 papers presented at the Symposium on Optical Fiber Measurements, held September 15-17, 1992, at the National Institute of Standards and Technology, Boulder, Colorado. Topics include fiber optics, instrumentation, measurements, optical fibers, and reviews. GRA

N93-21674# Los Alamos National Lab., NM.
OPTICAL CONSTANTS AND SCATTERING FACTORS FROM REFLECTIVITY MEASUREMENTS: 50 eV TO 5 keV
R. L. Blake, J. C. Davis, D. E. Graessle, T. H. Burbine (Smithsonian Astrophysical Observatory, Cambridge, MA.), and E. M. Gullikson 1992 13 p Presented at the Anomalous Scattering International Conference, Malente, Germany, 17-21 Aug. 1992
(Contract W-7405-eng-36)
(DE93-003750; LA-UR-92-3491; CONF-9208184-1) Avail: CASI HC A03/MF A01

An improved reflection technique was introduced to permit more accurate measurements of material optical constants delta and beta, the density

rho, and from these the atomic scattering factors f' and f''. Regions of normal and anomolous dispersion can be measured with resolving power 1000 or larger using a portable reflectometer that is moved to any of three beamlines at NSLS or two at CHESS. Herein the reflectometer and measurement techniques are described together with sample characteristics and preliminary results for the Ni LIII edge and the M edges of Au, Pt, and Ir. The primary accuracy limiting factors are density determination, accumulation of surface oxides or carbonaceous deposits, and synchrotron orbit stability. Each sample must be prepared for the specific energy range to be measured so that model fitting routines have the minimum possible number of free variables. DOE

N93-21804# Science Applications International Corp., San Diego, CA. Foreign Applied Sciences Assessment Center.
OPTOELECTRONICS RESEARCH IN THE FORMER SOVIET UNION Technical Assessment Report
H. C. Casey, Jr., S. G. Bishop, E. Eichen, R. F. Kazarinov, and H. F. Taylor May 1992 223 p
(PB93-111516) Avail: CASI HC A10/MF A03

Optoelectronics research in the former Soviet Union has been examined in the areas of eptitaxial layer growth and device processing, photonic devices such as semiconductor laser and photodetectors, high-speed lasers, the integration of photonic devices and transistors for optoelectronic integrated circuits (OEIC's), optical amplifiers, optoelectronic switching, and optical communications. These devices are largely prepared with 3-5 compound semiconductors. The assessment by a panel of US experts is based on a review of the translated Soviet technical literature, supplemented by information from recent visits to the former Soviet Union. The majority of Soviet optoelectronic devices were fabricated on wafers prepared by liquid-phase epitaxy. The strongest area of Soviet optoelectronic device research has been semiconductor lasers. No reports of ER(3+)-doped fiber amplifiers were found in the Soviet literature. However, Er(3+)-doped fiber fabrication is extremely simple, and, given its traditional strengths in the area of glass fabrication, the former Soviet Union should have the capability to fabricate Er(3+)-doped optical-fiber amplifiers. The current turmoil in the former Soviet Union makes predictions of the future difficult. It is likely that researchers will be driven to develop funding ties with foreign entities, and they also will become better integrated into the world research community by publishing in foreign (mainly US) journals. GRA

N93-22008*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
OPTICAL FIBER FLUOROSENSOR Patent Application
Claudio O. Egalon, inventor (to NASA) (College of William and Mary, Hampton, VA.) and Robert S. Rowgowski, inventor (to NASA) 16 Sep. 1991 15 p
(NASA-Case-LAR-14525-1-CU; NAS 1.71:LAR-14525-1-CU; US-Patent-Appl-SN-761298) Avail: CASI HC A03/MF A01

Optical fibers may have applications including fluorosensors which sense the concentration of an analyte. Like communication fibers, these fluorosensors are modeled using a weakly guiding approximation which is only effective when the difference between the respective refractive indices of the fiber core and surrounding cladding are minimal. An optical fiber fluorosensor is provided having a portion of a fiber core which is surrounded by an active cladding which is permeable by the analyte to be sensed and containing substances which emit light waves upon excitation. A remaining portion of the fiber core is surrounded by a guide cladding which guides these light waves to a sensor which detects the intensity of waves, which is a function of the analyte concentration. Contrary to conventional weakly guiding principles, the difference between the respective indices of refraction of the fiber core is surrounded by an active cladding which is thin enough such that its index of refraction is effectively that of the surrounding atmosphere, thereby the atmosphere guides the injective indices of the fiber core and the cladding results in an unexpected increase in the power efficiency of the fiber core. NASA

N93-21416*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
OPTICAL CORRELATORS FOR AUTOMATED RENDEZVOUS AND CAPTURE Abstract Only
Richard D. Juday *In* NASA, Washington, NASA Automated Rendezvous and Capture Review. Executive Summary 1991 p 10-11 (For primary document see N93-21407 07-12)
Avail: CASI HC A01/MF A01

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N93-20026# Georgia Inst. of Tech., Atlanta. Fusion Research Center.
POLOIDAL ROTATION, DENSITY ASYMMETRIES, AND MOMENTUM CONFINEMENT IN TOKAMAK EXPERIMENTS
W. M. Stacey and D. R. Jackson Aug. 1992 25 p
(Contract DE-FG05-87ER-51112)
(DE93-002319; GTFR-103) Avail: CASI HC A03/MF A01

Poloidal rotation speeds and density asymmetries are calculated for the deuterium and dominant carbon (oxygen) impurity ions in discharges in ASDEX, DIII, ISX-B, JET, and TFTR for which upsilon(sub (phi) is approximately upsilon(sub th) for the ions. These poloidal rotation speeds and density asymmetries are used to evaluate the neoclassical gyroviscous model for the momentum confinement time. The rather good agreement with experimental momentum confinement times obtained over this wide range of plasma parameters provides a measure of confidence in the calculated density asymmetries and poloidal rotation, as well as arguing for a neoclassical explanation for momentum confinement in tokamaks. DOE

N93-20030# Oak Ridge National Lab., TN.
DIMENSIONLESS SCALING OF CONFINEMENT IN ATF
M. Murakami, T. S. Bigelow, J. B. Wilgen, R. A. Dory, B. A. Carreras, D. B. Batchelor, L. R. Baylor, G. L. Bell, J. D. Bell, and R. J. Colchin et al 1992 11 p Presented at the 14th International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Wuerzburg, Germany, 30 Sep. - 7 Oct. 1992
(Contract DE-AC05-84OR-21400)
(DE93-001705; CONF-920913-3) Avail: CASI HC A03/MF A01

The results of dimensionless-parameter modulation and configuration control experiments in the Advanced Toroidal Facility (ATF) are presented. The global energy confinement time fits gyro-Bohm scaling better than Bohm-like scaling. An additional dependence was detected by modulation of single dimensionless parameters (collisionality nu(sub *) and beta (beta)), yielding tau(sub E)/tau(sub gB) is proportional to (((nu(sub *))(sup(alpha(sub nu)))(beta(sup (alpha(sub beta)), where alpha(sub nu) = 0.18 plus or minus 0.03 and alpha(sub beta) = 0.3 plus or minus 0.1. Application of this formula to NBI and ECH data significantly improves the fit, implying that improved confinement will result from increasing the heating power. Little change in confinement occurred for wide variations in the confined trapped particle fraction at constant magnetic well radius and shear. This may be explained by reduction of the helically trapped particle loss region due to the radial electric field. Configuration modulation experiments showed that the energy confinement time improves as the magnetic well radius expands, the result expected from some stabilization of resistive interchange instabilities. This is consistent with fluctuation measurements and may explain the positive dependence of confinement on beta. DOE

N93-20112# National Inst. for Fusion Science, Nagoya (Japan).
EFFECTS OF NONCLASSICAL ION LOSSES ON RADIAL ELECTRIC FIELD IN CHS TORSATRON/HELIOTRON
Heiji Sanuki, Kimitaka Itoh, and Sanae-I. Itoh Jul. 1992 51 p Sponsored by the Japanese Ministry of Education
(NIFS-160; AD-B168318L) Avail: CASI HC A04/MF A01

A self consistent analysis is discussed to determine the radial electric field and loss cone boundary in torsatron/heliotron plasmas under the influence of nonclassical ion losses. Effects of the loss cone, charge exchange loss of fast ions with neutrals, and the bipolar part of anomalous loss are taken into account. Analysis is applied to the neutron beam injection (NBI) heated plasma in the compact helical systems (CHS) device. Comparison is made between theoretical results and experimental observations. The increased ion particle losses by the orbit loss and charge exchange loss with neutrals make the radial electric field more negative

than the value of purely neoclassical calculation. The partition of the injection energy among the shine through, direct orbit loss, charge exchange loss, and bulk heating is estimated by using the self-consistent electric field profile. The power loss of fast ions caused by the orbit loss or charge exchange process is by a factor of several tens to hundreds greater than the reduction of the energy loss of bulk ions through the enhancement of radial electric field. Comparison with W7-A experiment is made, and the differences are discussed. Author

N93-20113# National Inst. for Fusion Science, Nagoya (Japan).
HIGH FREQUENCY ION BERNSTEIN WAVE HEATING EXPERIMENT ON JIPP T-2U TOKAMAK
T. Seki, R. Kumazawa, T. Watari, M. Ono (Princeton Univ., NJ.), Y. Yasaka (Kyoto Univ., Japan.), F. Shimpo, A. Ando, O. Kaneko, Y. Oka, and K Adati et al Aug. 1992 42 p Prepared in cooperation with Tokyo Univ., Japan, and Chubu Univ., Kasugai, Japan
(NIFS-165; AD-B168327L) Avail: CASI HC A03/MF A01

An experiment in a new regime of ion Bernstein wave (IBW) heating has been carried out using 130 MHz high power transmitters in the JIPP T-IIU tokamak. The heating regime utilized the IBW branch between the 3rd and 4th harmonics of the hydrogen ion cyclotron frequencies. This harmonic number is the highest among those used in the IBW experiments ever conducted. The net radio-frequency (RF) power injected into the plasma is around 400 kW, limited by the transmitter output power. Core heating of ions and electrons was confirmed in the experiment and density profile peaking was found to feature the IBW heating (IBWH). The peaking of the density profile was also found when IBW was applied to the neutral beam injection heated discharges. An analysis by use of a transport code with these experimental data indicates that the particle confinement should be improved in the plasma core region on the application of IBWH. It is also found that the ion energy distribution function observed during IBWH has a shorter energy tail than those in the conventional ion cyclotron range of frequency heating regimes. The observed IBWH-produced ion energy distribution function is in a reasonable agreement with the calculation based on the quasi-linear RF diffusion/Fokker-Planck model. Author

N93-20154# National Inst. for Fusion Science, Nagoya (Japan).
ON A BALLISTIC METHOD FOR DOUBLE LAYER REGENERATION IN A VLASOV-POISSON PLASMA
Sergey V. Bazdenkov (Kurchatov, I. V. Inst. of Atomic Energy, Moscow, USSR.) and Tetsuya Sato Jun. 1992 29 p
(NIFS-153) Avail: CASI HC A03/MF A01

Double layers generated by a current-driven instability are extant for a short time and then destroyed by emitting solitons and other nonlinear waves. It is analytically shown that they can be regenerated in the one-dimensional Vlasov-Poisson plasma system where the upstream velocity distribution is swiftly heated to restore an unstable condition in the downstream region due to ballistic deformation. Author (revised)

N93-20155# National Inst. for Fusion Science, Nagoya (Japan).
STEADY STATE TOKAMAK SUSTAINED BY BOOTSTRAP CURRENT WITHOUT SEED CURRENT
Kimitaka Itoh, Sanae-I. Itoh, and Atsushi Fukuyama (Okayama Univ., Japan.) Jul. 1992 17 p Sponsored by the Japanese Ministry of Education
(NIFS-159; AD-B168317L) Avail: CASI HC A03/MF A01

The steady state tokamak solution is studied in the context of the current diffusivity. The seed current for generating the Bootstrap current is supplied through the radial diffusion of the Bootstrap current. Steady state tokamak operation, without external current drive power, is, in principle, possible. Author (revised)

N93-20156# National Inst. for Fusion Science, Nagoya (Japan).
TRANSITION TO H-MODE BY ENERGETIC ELECTRONS
Kimitaka Itoh and Sanae-I. Itoh Jul. 1992 18 p Sponsored by the Japanese Ministry of Education
(NIFS-158; AD-B168316L) Avail: CASI HC A03/MF A01

The effect of electron loss, due to toroidal ripple, on H-mode transition is studied. When energetic electrons exist in tokamaks, e.g., in the case of current drive by lower hybrid (LH) waves, the edge electric field can show the bifurcation to the more positive value. In this state, both the electron loss and ion loss (such as loss cone loss) are reduced. The criterion for the transition is derived. Comparison with the H-mode in the JT-60 LH plasma shows a qualitative agreement. Author (revised)

N93-20157# National Inst. for Fusion Science, Nagoya (Japan).
PHYSICS AND ENGINEERING DESIGN STUDIES ON LARGE HELICAL DEVICE
O. Motojima, K. Akaishi, K. Fujii, S. Fujiwaka, S. Imagawa, H. Ji, H. Kaneko, S. Kitagawa, Y. Kubota, and K. Matsuoka et al Aug. 1992 34 p
(NIFS-161; AD-B168322L) Avail: CASI HC A03/MF A01

The construction of the Large Helical Device (LHD) is progressing as a 7 year project in Japan. The project began in 1990. This year, necessary research and development programs are approaching the final goal of the original schedule, and we have started the construction of the basic components of the LHD. We report on the results of the physics and engineering design studies and the recent status of the construction of LHD. Author (revised)

N93-20158# National Inst. for Fusion Science, Nagoya (Japan).
REFINED THEORY OF DIAMAGNETIC EFFECT IN STELLARATORS
V. D. Pustovitov (Kurchatov, I. V. Inst. of Atomic Energy, Moscow, USSR.) Aug. 1992 21 p
(NIFS-162; AD-B168323L) Avail: CASI HC A03/MF A01

The difference delta(phi) between the toroidal magnetic flux phi(sub p) through the plasma cross-section and the same flux phi(sub v) of a vacuum magnetic field is calculated analytically for 'conventional' stellarators with a planar circular axis. It was done without limitations on the aspect ratio, shape, or position of the plasma. The results obtained show weak dependence of delta(phi)/phi(sub p) on the geometry of the equilibrium configuration. It proves that diamagnetic measurements can be considered as a reliable basis for the direct evaluation of stored plasma energy at various experimental conditions. Author (revised)

N93-20159# National Inst. for Fusion Science, Nagoya (Japan).
THOUGHT ANALYSIS ON SELF-ORGANIZATION THEORIES OF MHD PLASMA
Yoshiomi Kondoh (Gunma Univ., Japan.) and Tetsuya Sato Aug. 1992 59 p
(NIFS-164; AD-B168319L) Avail: CASI HC A04/MF A01

A thought analysis on the self-organization theories of dissipative MHD plasmas is presented to lead to three groups of theories that lead to the same relaxed state of del x B = lambda(B), in order to find an essential physical picture embedded in the self-organization phenomena due to nonlinear and dissipative processes. The self-organized relaxed state due to the dissipation by the Ohm loss is shown to be formulated generally as the state such that yields the minimum dissipation rate of global auto- and/or cross-correlations between two quantities in j, B, and A for their own instantaneous values of the global correlations. Author (revised)

N93-20249# National Inst. for Fusion Science, Nagoya (Japan).
A SYNERGETIC TREATMENT OF THE VORTICES BEHAVIOUR OF A PLASMA WITH VISCOSITY
Vo Hong Anh (Vietnam National Atomic Energy Commission, Hanoi.) and Nguyen Tien Dung (Vietnam National Atomic Energy Commission, Hanoi.) Sep. 1992 11 p
(NIFS-166; AD-B168321L) Avail: CASI HC A03/MF A01

The known system of nonlinear differential equations (PDE) describing vortical motions of an ideal electron-ion plasma with viscosity in the presence of a slightly inhomogeneous magnetic field is reduced to a Lorentz type system of 3 ordinary differential equations (ODE). The numerical solution of this system, with a set of values for real plasma physical parameters, shows the occurrence of a state with strange attractors. This means that the beginning of the vortices' formation is essentially a nonlinearity effect. Author

N93-20263# National Inst. for Fusion Science, Nagoya (Japan).
PHYSICAL MECHANISM OF E(SUB PSI)-DRIVEN CURRENT IN ASYMMETRIC TOROIDAL SYSTEMS
Noriyoshi Nakajima, Masao Okamoto, and Masami Fujiwara Sep. 1992 22 p
(NIFS-172; AD-B168928L) Avail: CASI HC A03/MF A01

Physical mechanism of the E sub psi-driven neoclassical current which

exists only in asymmetric toroidal systems is clarified. It is found that symmetry-breaking, violating the total angular momentum conservation, changes the direction of flow and heat flux to be damped by the parallel viscosities. The change in the direction depends on the collisionality through the geometric factor which reflects symmetry-breaking. As a result, in contrast to symmetric toroidal systems, the flow and heat flux due to the radial electric field E sub psi can be damped according to the collisionality in asymmetric toroidal systems. If dominant species such as electrons and primary ions have different collisionalities, there remains a difference between the flows due to E psi, hence a parallel current proportional directly to the radial electric field, i.e., the E psi-driven current, is generated in asymmetric toroidal systems in spite of the charge neutrality condition. Author

N93-20264# National Inst. for Fusion Science, Nagoya (Japan).
SELFCONSISTENT ANALYSIS OF RADIAL ELECTRIC FIELD AND FAST ION LOSSES IN CHS TORSATRON/HELIOTRON
H. Sanuki, K. Itoh, and S.-I. Itoh (Kyushu Univ., Fukuoka, Japan.) Sep. 1992 20 p Presented at the IAEA Technical Committee Meeting on Tokamak Plasma Biasing, Montreal, Ontario, 8-10 Sep. 1992 Submitted for publication
(NIFS-178; AD-B169202L) Avail: CASI HC A03/MF A01

A self consistent analysis is developed to determine the radial electric field and loss cone boundary in Torsatron/Heliotron plasmas under the influence of non-classical ion losses such as the loss cone loss and charge exchange loss of fast ions with neutrals. Analysis is applied to the NBI heated plasmas in the Compact Helical System (CHS) device. Comparison is made between theoretical results and experimental observations. The increased ion particle losses caused by the orbit loss and charge exchange loss with neutrals make the radial electric field more negative than the value of purely neoclassical calculation. The partition of the injection energy among the shine through, direct orbit loss, charge exchange loss, and bulk heating is evaluated by using the selfconsistent electric field profile. On-going experiments in the CHS device are briefly introduced. Author

N93-20265# National Inst. for Fusion Science, Nagoya (Japan).
EFFECT OF ALPHA PARTICLES ON RADIAL ELECTRIC FIELD STRUCTURE IN TORSATRON/HELIOTRON REACTOR
K. Itoh, H. Sanuki, and S.-I. Itoh (Kyushu Univ., Fukuoka, Japan.) Sep. 1992 29 p Submitted for publication
(NIFS-182; AD-B169201L) Avail: CASI HC A03/MF A01

The radial electric field structure in the fusion reactor of the Torsatron/Heliotron configuration is discussed taking into account the effects of the orbit loss of alpha particles. It was found that the direct loss of alpha-particles has small influence on the profile of the radial electric field. The trapping efficiency of the alpha particle is also evaluated by using the self-consistent radial electric field. Author (revised)

N93-20282 Texas Univ., Austin.
THE EFFECTS OF EXTERNALLY IMPOSED MAGNETIC PERTURBATIONS ON PLASMAS IN TEXT Ph.D. Thesis
Mark Stephen Foster 1992 128 p
Avail: Univ. Microfilms Order No. DA9239252

The Texas Experimental Tokamak (TEXT) has a set of eight perturbing coils which imposes a spatially resonant radial magnetic field structure on a tokamak plasma. These coils were designed to produce a magnetic perturbation with an m = 7, n = 2 mode structure. This perturbation produces magnetic island chains on the rational surfaces in the plasma. The perturbing coils are driven with alternating current in a 2-8 kHz range of frequencies, thus oscillating the magnetic islands. These frequencies are of the same order as the natural MHD oscillations in TEXT. When used in this manner, the imposed magnetic perturbation is termed the Resonant Helical Oscillator (RHO). A theoretical model developed by Dr. Alan Boozer predicts that currents will flow on the perturbed rational surfaces so as to oppose the applied magnetic perturbation. The plasma parameters of density, current, toroidal field, and working gas, and the RHO settings of frequency and current are varied to characterize the plasma response under several conditions. The plasma response to the RHO is detected by a special set of sensing coils and compared to the predictions of the model. The experimental data from these coils supports the theory that small toroidal currents are being driven by the RHO on the island chains. For normal TEXT plasmas exhibiting low levels of MHD activity, these currents oppose the applied perturbations as predicted. The magnitude of the plasma response increases with perturbation frequency and strength as expected. In addition, the plasma response from the perturbed resonant surfaces appears to exhibit the predicted inverse relationship to the local parallel resistivity. This type of measurement can thus be used to measure changes in Z(sub eff) on the resonant rational surfaces. The phase shift of the plasma response is also examined and its dependences are consistent with a model of the plasma as an inductive element. Although the general trends predicted by Boozer's model are supported by the experimental evidence, the magnitude of the response is typically 2-3 times greater than the theoretical value. This could be due to coupling between the applied perturbations and the naturally occurring tearing modes in the plasma. Dissert. Abstr.

N93-20294# National Inst. for Fusion Science, Nagoya (Japan).
REVIEW OF JAPANESE RESULTS ON HEATING AND CURRENT DRIVE
T. Watari Oct. 1992 55 p Presented at the Europhysics Topical Conference on Radiofrequency Heating and Current Drive of Fusion Devices, Brussels, Belgium, 1992 Submitted for publication
(NIFS-193) Avail: CASI HC A04/MF A01

This article discusses Japanese contributions in the fields of plasma heating and current drive and, together with other reviews presented at this conference, will serve as a reference for future investigations. The Japanese fusion community has several tokamaks: JAERI (STA) has JT-60 and JFT-2M. TRIAM-1M (Kyushu University), WT-3 (Kyoto University), and JIPP T-2 U (National Institute for Fusion Science (NIFS)) belong to the Ministry of Education (MOE). A lot of contributions were made by these devices in heating and current drive in the various frequency ranges: electron cyclotron (EC) frequency range, lower hybrid (LH) frequency range, and ion cyclotron (IC) frequency range. This paper only deals with tokamak results: results on LHCD are described in section 1; ECH is described in section 2; results of high power ICRF heating are given in section 3; IBWH is described in section 4; and finally, FWCD is covered in section 5. Because the Matrix of different machine and different frequency range gives an intractable list of results, sampling will be made in describing the progress, i.e., JT-60 for LHCD, WT-3 for ECH/CD, JIPP T-2 U for IBWH, and JT-60 for higher harmonic ICRF heating. Special attention is given to the investigation of fast wave current drive which has some history in Japan. Results from JIPP T-2 U, JFT-2M, HT-2, and JT-60 are summarized. Aside from the tokamak, MOE has an alternative magnetic fusion program centered around CHS and HELIOTORON-E (Kyoto University). The LHD (Large Helical Device) is a machine under construction in the new site of NIFS. Gamma-10 (Tsukuba University) and HIEI (Kyoto University) are tandem mirror type open end systems. Due to the allotted space, works in this field will not be covered in this review. It should also be noted that there are a lot of contributions in theory which continued to support experiments very strongly through this decade. Derived from text

N93-20362*# Aerospace Corp., El Segundo, CA. Engineering and Technology Group.
FORCE BALANCE NEAR AN X LINE ALONG WHICH E (DOT) IS LESS THAN 0
L. R. Lyons and D. C. Pridmore-Brown 15 Sep. 1992 11 p
(Grant NAGw-2126)
(NASA-CR-192341; NAS 1.26:192341; AD-A258640; ATR-91(7234)-2)
Avail: CASI HC A03/MF A01

Observations suggest that plasma can occasionally be transferred from closed to open field lines in the Geomagnetic tail during periods when the separatrix between open and closed field lines moves rapidly toward decreasing latitudes. Such transfer would require E (dot) J greater than 0 along the distant tail X line (E being the electric field and J the current density), and it would give important information on the physical processes that occur near an X line. The condition E (dot) J greater than 0 is not allowed in resistive reconnection theory. Collisionless reconnection theory, however, requires a balance between the electric force and a gyroviscous force at an X line but does not necessarily require that E (dot) J less than 0. We have recently shown that gyroviscosity can provide the force required to balance the electric force along an X line having E (dot) J greater than 0. GRA

N93-20543# National Inst. for Fusion Science, Nagoya (Japan).
EFFECTS OF NET TOROIDAL CURRENT ON MERCIER CRITERION IN THE LARGE HELICAL DEVICE
Katsuji Ichiguchi, Noriyoshi Nakajima, Masao Okamoto, Yuji Nakamura (Kyoto Univ., Uji, Japan.), and Masahiro Wakatani (Kyoto Univ., Uji, Japan.) Sep. 1992 44 p Submitted for publication
(NIFS-174; AD-B168891L) Avail: CASI HC A03/MF A01

Effects of the net toroidal current on the local ideal MHD stability or the Mercier criterion are investigated for a plasma in the heliotron/torsatron configuration by taking the Large Helical Device as an example. The three dimensional equilibrium code, VMEC, is used to study the local stability of equilibria with given net toroidal current. It is found that a subtractive current which decreased the rotational transform improves the stability while an additive current which increases the rotational transform deteriorates the stability. The change of the rotational transform of the magnetic axis due to the net toroidal current is the essential mechanism for the change of the stability property. Stability diagrams are drawn against the Mercier criterion for the configuration of the Large Helical Device shifting the plasma position inward or outward. Author

N93-20544# National Inst. for Fusion Science, Nagoya (Japan).
LONG PULSE DISCHARGES SUSTAINED BY SECOND HARMONIC ELECTRON CYCLOTRON HEATING USING A 35 GHz GYROTRON IN THE ADVANCED TOROIDAL FACILITY
S. Morimoto, M. Sato, H. Yamada, H. Ji, S. Okamura, S. Kubo, O. Motojima, M. Murakami (Oak Ridge National Lab., TN.), T. C. Jernigan (Oak Ridge National Lab., TN.), and T. S. Bigelow (Oak Ridge National Lab., TN.) et al Sep. 1992 15 p Submitted for publication
(NIFS-183; AD-B168890L) Avail: CASI HC A03/MF A01

A second harmonic electron cyclotron heating (ECH) discharge was sustained for approximately 20 s in the Advanced Toroidal Facility (ATF) at relatively weak magnetic field of B = 0.63 T. The high electron temperature (T(sub eo) approximately 700 eV), helium plasmas were produced with ECH power of P = 100-200 kW from a 35 GHz gyrotron. The line-averaged electron density and stored plasma energy were 2.3 x 10(exp 18) m(exp -3) and 300-500 J, respectively. The stored energy follows closely the gyro-reduced Bohm confinement scaling law. The maximum discharge duration was limited by ECH pulse duration but not by plasma collapse. Diagnostic signals showed attainment of a quasi-stationary plasma and no impurity build-up was indicated by soft x-ray and VUV spectroscopic signals. Author (revised)

N93-20545# National Inst. for Fusion Science, Nagoya (Japan).
MODEL OF THE L-MODE CONFINEMENT IN TOKAMAKS
K. Itoh, S.-I. Itoh (Kyoto Univ., Uji, Japan.), A. Fukuyama (Okayama Univ., Japan.), M. Yagi (Japan Atomic Energy Research Inst., Naka.), and M. Azumi (Japan Atomic Energy Research Inst., Naka.) 16 Sep. 1992 13 p Conference on Plasma Physics and Controlled Nuclear Fusion Research of the Fourteenth IAEA held in Wuerzburg, Germany, 30 Sep. - 7 Oct. 1992 Submitted for publication
(NIFS-187; IAEA-CN-56/H; AD-B169730L) Avail: CASI HC A03/MF A01

Model of the L-mode confinement in tokamaks is developed based on the microscopic ballooning mode instability. The anomalous transport coefficients determine the stability below the critical beta against the ideal MHD ballooning instability. The current-diffusivity has strong destabilizing effect, while the thermal transport chi and ion viscosity tend to stabilize the mode. The stability boundary for the least stable microscopic ballooning mode determines the anomalous transport coefficients. The obtained formula is compared with experimental observations on the L-mode confinement. The predictions on (1) the radial shape of chi, (2) the temperature-profile resilience, (3) the global confinement characteristics, such as the power degradation and the dependences on the plasma current, current profile and mass number, and (4) the ratio of the perturbative chi to the energy balance chi are consistent with the experimental database. Author (revised)

N93-20546# National Inst. for Fusion Science, Nagoya (Japan).
BETA-LIMITING PHENOMENA IN HIGH-ASPECT-RATIO TOROIDAL HELICAL PLASMAS
K. Itoh, A. Fukuyama (Okayama Univ., Japan.), and S.-I. Itoh (Kyoto Univ., Uji, Japan.) Oct. 1992 34 p Submitted for publication
(NIFS-188; AD-B169726L) Avail: CASI HC A03/MF A01

Evolutions of the local pressure gradient and the amplitude of the helical mode are studied near the critical pressure gradient against the linear resistive interchange instability in high aspect ratio toroidal helical plasmas. Three characteristic dynamic evolutions are identified; monotonous saturation, relaxation oscillation and periodic limit cycle solution. As the heating power is increased, the dynamic evolution changes from the monotonous saturation, to the relaxation oscillation and finally to the limit cycle. The time average of the pressure gradient is limited by the critical gradient against the linear stability. Dependences of the amplitude and period of the sawtooth oscillation on the heating power are also analyzed. Author (revised)

N93-20547# National Inst. for Fusion Science, Nagoya (Japan).
CROSS FIELD ION MOTION AT SAWTOOTH CRASH
K. Itoh, S.-I. Itoh (Kyoto Univ., Uji, Japan.), and A. Fukuyama (Okayama Univ., Japan.) Oct. 1992 16 p Submitted for publication
(NIFS-189; AD-B169731L) Avail: CASI HC A03/MF A01

Turbulent ion motion which is caused by the sawtooth crash is analyzed in the framework of the magnetic stochasticity model of the sawtooth crash. The average current profile changes much more slowly than the pressure profile after the onset of the crash, so that inhomogeneity of the parallel current along the field line is generated. This causes the perpendicular current with a short scale length, leading to the ion cross field motion. Author

N93-20600# Stanford Univ., CA. Dept. of Mechanical Engineering.
FUNDAMENTAL PROCESSES IN PARTIALLY IONIZED PLASMAS Final Report, 1 Jul. 1988 - 30 Sep. 1992
Charles H. Kruger and Christophe Laux Nov. 1992 81 p
(Grant AF-AFOSR-0264-88)
(AD-A259272; AFOSR-93-0007TR) Avail: CASI HC A05/MF A01

This report describes research results on Fundamental Processes in Partially Ionized Plasmas obtained in the High Temperature Gasdynamics Laboratory at Stanford University. This research has emphasized studies of plasma properties and associated diagnostics. The present report discusses, in the first part, optical diagnostics in air plasmas and, in the second part, measurements of the radiative emission of such plasmas. These experimental results have unveiled severe deficiencies in existing computer codes such as the widely used NASA code NEQAIR. Several modeling improvements are therefore proposed and included into NEQAIR. As a result, the enhanced version of the code is capable of predicting the radiative emission of air plasmas with better than 20 percent accuracy, as opposed to only orders of magnitude with the original version. Finally, the report presents first measurements of the radiative source strength of air for temperatures in the range between 5000 and 7500 K. To our knowledge, these are the first measurements of this important property in this temperature range. Excellent agreement is again obtained with the predictions of the enhanced NEQAIR code. GRA

N93-20760*# Massachusetts Inst. of Tech., Cambridge. Plasma Fusion Center.
RADIO STIMULATION AND DIAGNOSTICS OF SPACE PLASMAS Progress Report
Min-Chang Lee 1 Feb. 1993 107 p
(Grant NAG5-1055)
(NASA-CR-192366; NAS 1.26:192366) Avail: CASI HC A06/MF A02

We have investigated the small-scale topside ionospheric plasma structures first observed at Millstone Hill, Massachusetts with the 440 MHz incoherent scatter radar. These small-scale obliquely propagating plasma modes occurring in the vicinity of the midlatitude ionospheric trough, have large radar cross-sections and narrow spectral widths. They have, until recently, been dismissed solely as hard target contamination of the incoherent scatter radar. The geophysical conditions associated with the ionospheric trough, such as the field-aligned current activity and steep plasma density gradients, suggest that these recently discovered small-scale topside ionospheric plasmas may also appear in the auroral and polar ionosphere. In fact, this speculation has been corroborated by the preliminary experiments and data analyses at Tromso, Norway and Sondrestromfjord, Greenland. The primary research results are highlighted. Described in Section 3 are the experiments conducted at Arecibo, Puerto Rico in the past

summer for simulating the geophysical conditions of generating these topside ionospheric plasma structures. Recommendation for the future research is finally given. Attached as the appendix of this report are several chapters which present the detailed results of research in the concerned topside ionospheric clutter. Highlights of the research results include: (1) causes of the enhanced radar backscatter (ERB) phenomenon; (2) occurrence of the ERB phenomenon; (3) altitudes of the ERB phenomenon; (4) strength of the ERB returns; (5) range of altitudes of the ERB returns; (6) occurrence frequency of the ERB phenomenon; (7) Doppler effect of the ERB phenomenon; (8) persistency of the ERB; and (9) distinction between ERB phenomenon and space object signatures. Derived from text

N93-20761# National Inst. for Fusion Science, Nagoya (Japan).
DISCRIMINANT ANALYSIS OF PLASMA FUSION DATA
O. J. W. F. Kardaun (Max-Planck-Inst. fuer Plasmaphysik, Garching, Germany.), J. W. P. F. Kardaun (Netherlands Bureau of Statistics, Voorburg.), Sanae-I. Itoh, and Kimitaka Itoh Jun. 1992 14 p Presented at the 10th International Symposium of Computational Statistics, Lausanne, Switzerland, 24-28 Aug. 1992
(NIFS-156) Avail: CASI HC A03/MF A01

Discriminant analysis is a branch of statistics with applications in many fields. One of these (a relatively new one) is nuclear fusion research, where one is interested in various types of plasma discharges produced in toroidal devices. In many instances, one has a small number, say 2 or 3, of different types of discharges under investigation. For instance, L-mode and H-mode discharges (L stands for Low confinement, and H for High confinement), or: H-mode discharges without ELM's, with 'small' ELM's, and with 'large' (giant) ELM's. The abbreviation ELM's stands for Edge Localized Modes, which are detected by light recording instruments. They enhance the outward transport of the plasma, including the plasma impurities, but if they are large, they produce a heavy heat load on material contacts of the plasma with the wall. There are typically 4 or 5 continuous variables, for instance plasma current Ip, magnetic field B(sub t), plasma electron density n(sub e), input heating power P(inj), that influence the type of discharge ('shot') that will occur. In addition, there may be a few (2 or 3) discrete variables that are physically expected to be important. Finally, there are a number of wall conditioning aspects, which influence the type of shots that will be produced. In the framework of the ITER project, a collaborative effort between Europe, GUS, Japan and the USA, an international fusion reactor device is being designed which is due to operate at the beginning of the next century. In this context, a database (ITERH.DB1) has been assembled containing plasma confinement data of about 1000 H-mode discharges from 6 different tokamaks. These data have been released for general use by plasma physicists and other interested scientists. We will use part of these data to illustrate various discriminant analysis techniques. Several discriminant analysis methods have been applied and compared to predict the type of ELM's in H-mode discharges: (1) quadratic discriminant analysis (linear discriminant analysis being a special case), (2) discrimination by non-parametric (kernel-) density estimates, and (3) discrimination by a produce multinomial model on a discretized scale. Practical evaluation was performed using SAS in the first two cases, and INDEP, a standard FORTRAN program, initially developed for medical applications, in the last case. We summarize the approach and its results. Derived from text

N93-20762# National Inst. for Fusion Science, Nagoya (Japan).
A REVIEW ON APPLICATION OF MHD THEORY TO PLASMA BOUNDARY PROBLEMS IN TOKAMAKS
Kimitaka Itoh Aug. 1992 67 p Presented at the 3rd International Workshop on Plasma Edge Theory Sponsored by the Japanese Ministry of Education
(NIFS-163; AD-B168324L) Avail: CASI HC A04/MF A01

A survey is made on the problems of the edge plasmas, to which the analyses based on the MHD theory have been successfully applied. Also discussed are the efforts to extend the model equation to more general (and important as well) problems such as H-mode physics. An overview is first made on the advantages of the MHD picture, and the necessary supplementary physics are examined. Next, one- and two-dimensional models of the spatial structure of the edge plasma is discussed. The results on the stationary structure, both analytical and numerical, are reviewed: typical examples as well as the scaling law are shown. The instabilities associated with edge plasma is next reviewed. The surface kink mode, ballooning mode, interchange mode, resistive interchange mode, and thermal instability are discussed. Role of the geometry such as the location of the X-point is studied. Influences of the atomic processes, and those of the radial electric field are also discussed. The analysis of the H-mode transition physics is finally discussed. The boundary plasma is a nonlinear media which possesses the possibility for bifurcation in which the radial electric field plays a key role. The model of the ion viscosity is also studied. Transition physics is developed. Analysis on the self-generating oscillation is shown and the relation with ELMs is discussed. After reviewing these problems, several comments are made as to the direction of future study. Author (revised)

N93-20763# National Inst. for Fusion Science, Nagoya (Japan).
A ROLE OF NEUTRAL HYDROGEN IN CHS PLASMAS WITH REHEAT AND COLLAPSE AND COMPARISON WITH JIPP T-IIU TOKAMAK PLASMAS
S. Morita, H. Yamada, H. Iguchi, K. Adati, R. Akiyama, H. Arimoto, M. Fujiwara, Y. Hamada, K. Ida, and H. Idei et al 14 Sep. 1992 15 p Conference on Plasma Physics and Controlled Nuclear Fusion Research of the Fourteenth IAEA held in Wuerzburg, Germany, 30 Sep. - 7 Oct. 1992 Submitted for publication
(NIFS-186; IAEA-CN-56/C-2-5) Avail: CASI HC A03/MF A01

Results are described on NBI plasmas of the Compact Helical System (CHS). An increase in the stored energy, which is called plasma 'reheat' is observed with density peaking when gas puffing is turned off in the high density region. A plasma collapse with large increase in radiation loss occurs even in discharges whose Z(sub eff) values (typically, less than 2-3) do not show any increase when the gas puffing is continued. Both phenomena are basically explained by the edge electron temperature due to the difference in the amount of edge hydrogen neutrals. After turning off the gas puffing, the central electron density n(sub e 0) shows an increase of 80 percent and the density peaking factor (n(sub e 0)/bar-n(sub e)) changes from 1.0 to 2.0 in typical cases, and a high inward velocity of the impurities appears (v = 20 m/s). The accumulation is studied in relation to the poloidal rotation and the edge temperature. These results are compared with results from plasmas with IOC- and H-modes in the JIPPT-IIU tokamak. Author (revised)

N93-20764# National Inst. for Fusion Science, Nagoya (Japan). Theory and Computer Simulation Center.
COMPREHENSIVE SIMULATION STUDY ON LOCAL AND GLOBAL DEVELOPMENT OF AURORAL ARCS AND FIELD-ALIGNED POTENTIALS
Tomohiko Watanabe (Tohoku Univ., Sendai, Japan.), Hiroshi Oya (Tohoku Univ., Sendai, Japan.), Kunihiko Watanabe, and Tetsuya Sato Oct. 1992 43 p
(NIFS-195; AD-B169729L) Avail: CASI HC A03/MF A01

Extensive three-dimensional computer simulations of the magnetosphere-ionosphere (M-I) coupling are performed to study self-excitation of auroral arcs with special emphasis on (1) nonlinear evolution of the feedback instability in the M-I coupling system; (2) controlling mechanisms of the auroral arc structure; (3) formation of a field-aligned electric potential structure in association with the development of the feedback instability; and (4) effects of the parallel potential generation on auroral arc development. As was already shown by Sato (1978) and Watanabe and Sato (1988), it is reconfirmed that the feedback instability produces a longitudinally elongated, latitudinally striated structure where the upward field-aligned current and the ionosphere density are locally enhanced. On top of this the present extended study reveals the following important new features: (1) The global distribution of the striation structure is primarily governed by the magnetospheric convection pattern and the ionospheric density distribution. (2) There appears a significant dawn-dusk asymmetry in the auroral arc formation, even though the apparent geometrical relationship is symmetric. This dawn-dusk asymmetry reflects the geometrical fact that the ionospheric Pedersen current closing the magnetospheric current is anti-symmetric with respect to the moon-midnight plane, while the self-closed Hall current is symmetric. (3) The recombination effect plays a significant role in the global, as well as local, development of the auroral arc structure. The nonlinearity of recombination, in conjunction with the closure of an arc-associated local field-aligned current system, acts to destroy an old arc and creates a new arc in a different but adjacent position. This results in a peculiar behavior of auroral arc formation and deformation. (4) A V-shaped field aligned potential structure is created in

association with an auroral arc. Rapid increase in the electron density and the local upward field-aligned current of an arc arises as a result of enhanced ionization by precipitating electrons accelerated by the parallel potential. (5) A drastic oscillatory behavior of appearance and disappearance of auroral arcs is obtained when the ionization effect is strong. The period is primarily given by the Alfven bounce time. Author (revised)

N93-20914*# Alabama Univ., Huntsville. Coll. of Science.
MAGNETOSPHERIC SPACE PLASMA INVESTIGATIONS Semiannual Progress Report, Jul. 1992 - Jan. 1993
Richard H. Comfort and James L. Horwitz Mar. 1993 10 p
(Grant NAG8-239)
(NASA-CR-192620; NAS 1.26:192620) Avail: CASI HC A02/MF A01

The topics addressed are: (1) generalized semikinetic models; (2) collision-collisionless transition model; (3) observation of O+ outflows; (4) equatorial transitions; (5) inner plasmasphere-ionosphere coupling; (6) plasma wave physical processes; (7) ULF wave ray-tracing; and (8) nighttime anomalous electron heating events. CASI

N93-20936# Technische Univ., Eindhoven (Netherlands).
SURFACE MODIFICATION USING A CASCADE ARC PLASMA SOURCE Ph.D. Thesis
Jacobus Johannes Beulens 1992 172 p Sponsored by Stichting voor Fundamenteel Onderzoek der Materie
(ETN-93-93065) Avail: CASI HC A08/MF A02

Investigations on the plasma physical aspects of a seeded argon cascade arc plasma, expanding into vacuum, used as a particle source for surface modifications are considered. The cascade arc particle source, the expansion with monomer seeding, and the surface modification and its interrelations are emphasized. The objective was to understand the plasma physical processes that govern the radical and ion fluxes impinging on the substrate, in relation with the external settings, and finally the parameters of the modified substrate. ESA

N93-21192# National Inst. for Fusion Science, Nagoya (Japan).
L-MODE CONFINEMENT MODEL BASED ON TRANSPORT-MHD THEORY IN TOKAMAKS
K. Itoh, M. Yagi (Japan Atomic Energy Research Inst., Naka.), S.-I. Itoh (Kyushu Univ., Fukuoka, Japan.), A. Fukuyama (Okayama Univ., Japan.), and M. Azumi (Japan Atomic Energy Research Inst., Naka.) Oct. 1992 20 p Submitted for publication
(NIFS-192) Avail: CASI HC A03/MF A01

Theory of the L-mode confinement in tokamaks is developed based on the microscopic ballooning instability which is destabilized by the plasma transport below the critical pressure gradient against the ideal MHD instability. The destabilization by the current-diffusivity and the stabilization by the thermal transport and ion viscosity are analyzed. The least stable mode determines the anomalous transport coefficients. The formula of the thermal transport coefficient is derived, which explains major experimental observations on the L-mode confinement. Author (revised)

N93-21193# National Inst. for Fusion Science, Nagoya (Japan).
FORMATION OF H-MODE LIKE TRANSPORT BARRIER IN THE CHS HELIOTRON/TORSATRON
K. Toi, S. Okamura, H. Iguchi, H. Yamada, S. Morita, S. Sakakibara, K. Ida, K. Nishimura, K. Matsuoka, and R. Akiyama et al 13 Oct. 1992 15 p Conference on Plasma Physics and Controlled Nuclear Fusion Research of the IAEA held in Wuerzburg, Germany, 30 Sep. - 7 Oct. 1992 Submitted for publication
(NIFS-198; IAEA-CN-56/H-1-3) Avail: CASI HC A03/MF A01

Control of rotational transform profile with a small ohmic heating (OH-) current to increase the rotational transform has led to a continuous rise in the line-averaged electron density with reduction of H-alpha lights around the torus, in a heliotron/torsatron plasma heated by neutral beams. During the density rise, the transport barrier with steep temperature and density gradients near the plasma edge has been formed. Edge localized modes (ELM)-like activity is also observed. Incoherent magnetic fluctuations in the frequency range f greater than 20 kHz are clearly suppressed during the density rise phase, while the low frequency coherent part remains almost unchanged. Global energy confinement time in the density rise phase is improved by approx. 15 percent, compared with that of the discharge without the OH- current. These experimental observations are very similar to the H-mode in tokamaks. There is a threshold of the current for the transition, where the increment of rotational transform by the threshold current corresponds to approx. 0.1 at the edge. No obvious increase in the edge poloidal rotation velocity, however, is observed during the density rise phase, that is, at most approx. 3 km/s. Author (revised)

N93-21203# National Inst. for Occupational Safety and Health, Cincinnati, OH. Div. of Physical Sciences and Engineering.
MODIFICATION AND EVALUATION OF A MICROWAVE PLASMA/ATOMIC EMISSION DETECTOR SYSTEM
M. Eileen Birch 14 May 1992 36 p
(PB92-217959) Avail: CASI HC A03/MF A01

Modifications made to an Applied Chromatography Systems plasma emission detector and the evaluation of the performance of the modified instrument were described. The detector modified was the MPD-850. The overall performance of the modified equipment was much improved for carbon (7440440) determination relative to that found for the original instrument. Limits of detection were somewhat higher for the other elements examined in the study including hydrogen (1333740), fluorine (778414), chlorine (7782505), bromine (7726956), and iodine (7553562). The carbon response for seven of the compounds examined in the study did not appear to be compound dependent when the helium flow rate was 70 milliliters/minute. Toluene (108883) and 2-chlorobutane (78864) responses were lower than expected. Carbon responses for two fluorinated compounds were also low, possibly as a result of a fluorine/quartz tube wall interaction. Modification of the original system included replacement of the 1/4 gamma cavity with a Beenakker TM010 cavity, replacement of the gas flow control unit with electronic mass flow controllers, addition of valves and plumbing associated with a solvent venting scheme, and construction of a gas chromatographic/plasma interface. GRA

N93-21208# Technische Hochschule, Darmstadt (Germany). Fachbereich Physik.
STIMULATED BRILLOUIN BACKSCATTERING FOR NONLINEAR IONIC SOUND WAVES IN LASER PLASMAS Ph.D. Thesis [STIMULIERTE BRILLOUIN RUECKTREUUNG AN NICHTLINEAREN IONENSCHALLWELLEN IN LASERPLASMEN]
Stefan Hueller 1990 123 p In GERMAN
(ETN-93-93415) Avail: CASI HC A06/MF A02

The basic model equations of involved electromagnetic waves are derived. Their characteristic features when propagating in inhomogeneous plasmas are reported. Ionic sound waves or ionic acoustic waves occurring in plasmas as low frequency components or the stimulated Brillouin scattering are dealt with. The order of magnitude of dissipative and dispersive levels are discussed. Taking as an assumption the existence of asymptotic stationary conditions, a new solution including daughter waves is presented. Its importance with regard to other solutions is discussed. The character and the rate of growth of the instability are examined. The wave particle action is characterized, and the action of rapid 'hot' ions on the stimulated Brillouin scattering is compared, using simulation results and a stationary model. ESA

N93-21361# National Inst. for Fusion Science, Nagoya (Japan).
DESIGN STUDY ON DIVERTOR PLATES OF LARGE HELICAL DEVICE (LHD)
N. Noda, Y. Kubota, A. Sagara, N. Ohyabu, K. Akaishi, H. Ji, O. Motojima, M. Hashiba (Hokkaido Univ., Sapporo, Japan.), I. Fujita, and T. Hino et al Oct. 1992 17 p The 17th Symposium on Fusion Technology was held in Rome, Italy, 14-18, 1992
(NIFS-190) Avail: CASI HC A03/MF A01

A conceptual design has been completed for the divertor plates of the Large Helical Device (LHD) (R = 3.9 m, a sub p = 50 to approximately 60 cm, B sub h = 3 to approximately 4T/superconducting coils of NbTi) and the detailed technical design is now in progress. The design concept and the status of research and development programs are described. Author

N93-21362# National Inst. for Fusion Science, Nagoya (Japan).
PUMPING EXPERIMENT OF WATER ON B AND LaB6 FILMS WITH ELECTRON BEAM EVAPORATOR
T. Mori (Muroran Inst. of Tech., Japan.), K. Akaishi, Y. Kubota, O. Motojima,

M. Mushiaki (Kawasaki Medical School, Kurashiki, Japan.), Y. Funato (Suzuka Coll. of Technology, Japan.), and Y. Hanaoka Oct. 1992 20 p
(NIFS-196) Avail: CASI HC A03/MF A01

Pumping characteristics of water vapor on boron and lanthanum hexaboride films formed with an electron beam evaporator have been investigated in high vacuum of a pressure region between 10(exp -4) and 10(exp -3) Pa. Measured initial maximum pumping speeds of water for fresh B and LaB6 films on substrates with a deposition amount from 2.3 x 10(exp 21) to 6.7 x 10(exp 21) molecules m (exp -2) are 3.2 to approximately 4.9 m/s, and maximum saturation amounts of adsorbed water on these films are 2.9 x 10(exp 20) to approximately 1.3 x 10(exp 21) H2O molecules/sq m. Author

N93-21405 Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
ION TRAPPING IN DUSTY PLASMAS
J. Goree (Iowa Univ., Iowa City.) Feb. 1992 11 p Submitted for publication
(MPE-Preprint-219; ETN-93-93530) Copyright Avail: Fachinformationszentrum Karlsruhe, 7514 Leopoldschafen-Eggenstein 2, Germany

Motivated by space and laboratory applications, a theory for trapped ions orbiting a charged dust grain in a plasma is presented. Trapped ions are confined within the grain's attractive Debye sphere, and they shield the grain's considerable electric charge. The number N(trap) is determined by the capture and loss rates, due to charge exchange collisions. At steady state, N(trap) is independent of the collisional mean free path and proportional to the plasma ion density. Because of the ion density dependence, trapping will be negligible in most space plasmas, but very significant in laboratory plasmas, which are usually much denser. ESA

N93-21482# Massachusetts Inst. of Tech., Cambridge. Plasma Fusion Center.
CURRENT-DRIVE AND PLASMA-FORMATION EXPERIMENTS ON THE VERSATOR-2 TOKAMAK USING LOWER-HYBRID AND ELECTRON-CYCLOTRON WAVES Ph.D. Thesis
J. A. Colborn Aug. 1992 235 p
(Contract DE-AC02-78ET-51013)
(DE93-002333; PFC/RR-92-13) Avail: CASI HC A11/MF A03

During lower-hybrid current-driven (LHCD) tokamak discharges with thermal electron temperature T(sub e) is approximately 150 eV, a two-parallel-temperature tail is observed in the electron distribution function. The cold tail extends to parallel energy E(sub parallel) is approximately 4.5 keV with temperature T is approximately 1.5 keV, and the hot tail extends to E(sub parallel) is approximately 4.5 keV with T greater than 40 keV. Fokker-Planck computer simulations suggest the cold tail is created by low power, high N(sub parallel) sidelobes in the lower-hybrid antenna spectrum, and that these sidelobes bridge the 'spectral gap', enabling current drive on small tokamaks such as Versator. During plasma-formation experiments using 28 GHz electron-cyclotron (EC) waves, the plasma is born near the EC layer, then moves toward the upper-hybrid (UH) layer within 100-200 microsec. Wave power is detected in the plasma with frequency f = 300 MHz, indicating the EC waves decay into ion modes and electron Bernstein waves during plasma formation. Measured turbulent plasma fluctuations are correlated with decay-wave amplitude. Toroidal currents up to I(sub p) is approximately 1 kA are generated, consistent with theory, which predicts asymmetric electron confinement. Electron-cyclotron current-drive (ECCD) is observed with loop voltage V(sub loop) is less than or equal to 0 and fully sustained plasma current I(sub p) is approximately less than 15 kA at densities up to n(sub e) = 2 x 10(exp 12) cm(sup -3). The ECCD efficiency eta is equivalent to n(sub e)I(sub p)R(sub O)/P(sub rf) = 0.003, which is 30-40 percent of the maximum achievable LHCD efficiency on Versator. The efficiency falls rapidly to zero as the density is raised above n(sub e) = 3 x 10(exp 12) cm(sup -3), suggesting the ECCD depends on low collisionality. X-ray measurements indicate the current is carried primarily by electrons with energies 1 keV is approximately less than E is approximately less than 10 keV. DOE

N93-21483# Wisconsin Univ., Madison. Dept. of Nuclear Engineering and Engineering Physics.
TFTR EXPERIMENTAL DATA ANALYSIS COLLABORATION
J. D. Callen Jun. 1992 8 p
(Contract DE-FG02-92ER-54139)
(DE93-002365; DOE/ER-54139/1) Avail: CASI HC A02/MF A01

The research performed under the initial year of this grant has concentrated on a few key Tokamak Fusion Test Reactor (TFTR) experimental data analysis issues: MHD effects on supershots; poloidal asymmetry effects in beam-heated plasmas; and analysis of transport processes in perturbed plasmas. Progress in these areas and activities undertaken in conjunction with this grant are summarized. DOE

N93-21567# National Inst. for Fusion Science, Nagoya (Japan).
VLASOV EQUATION IN THE STOCHASTIC MAGNETIC FIELD
Hideo Sugama, Masao Okamoto, and Masahiro Wakatani (Kyoto Univ., Uji, Japan.) Sep. 1992 27 p Submitted for publication
(NIFS-171; AD-B168929L) Avail: CASI HC A03/MF A01

We investigate the Vlasov equation in the stochastic magnetic field as a stochastic Liouville equation and derive the equation for the ensemble-averaged distribution function. The term resulting from the stochastic magnetic field has the derivatives with respect to both the velocity and the real space coordinates, which is a contrast to both the real space diffusion as seen in the guiding center picture and the velocity space diffusion as in the quasi-linear theory of the Vlasov equation including the electric field fluctuations. We find that this term retains the mass and energy conservation properties of the original Lorentz force due to the stochastic magnetic field and yields the additional force in the momentum equation. This additional force produced by the stochastic field gives the drift velocity which corresponds to the familiar real space diffusion of the guiding center in the stochastic field. The finite Larmor radius effect on the diffusion is also estimated. Author

N93-21568# National Inst. for Fusion Science, Nagoya (Japan).
ON RELATION BETWEEN HAMADA AND BOOZER MAGNETIC COORDINATE SYSTEM
Noriyoshi Nakajima, Jiro Todoroki, and Masao Okamoto Sep. 1992 25 p Submitted for publication
(NIFS-173; AD-B169200L) Avail: CASI HC A03/MF A01

The relation between the Hamada and the Boozer magnetic coordinate system is clarified by deriving them from a general magnetic field coordinate system. The coordinate transformation from the Hamada to the Boozer coordinate system is performed using a transformation function, which is easily calculated with the knowledge of the magnetic field strength only. In non-axisymmetric systems, the Fourier spectrum of the magnetic field strength (absolute value of B) in the Hamada coordinate system is broader than that in the Boozer coordinate system and the leading modes of (absolute value of B) in the Hamada coordinate system significantly deviate from a simple model field in comparison with the Boozer coordinate system. The Boozer coordinate system is suitable for numerical calculations, especially, for neoclassical and orbit calculations in non-axisymmetric systems. Author (revised)

N93-21668# Georgia Inst. of Tech., Atlanta. Biomedical Research Div.
NEOCLASSICAL THEORY OF THE PLASMA EDGE
W. M. Stacey Oct. 1992 20 p
(PB93-123586; GTFR-104) Avail: CASI HC A03/MF A01

Tokamak neoclassical theory is extended to the plasma edge region, where the gradient scale lengths of density, temperature, and rotation are comparable to the ion poloidal gyroradius and where v(sub theta) B(sub phi)/v(sub th) B(sub theta) approx = O(1). A new drift due to viscosity is found to be important. A self-consistent set of equations for determining particle flows within and across flux surfaces, asymmetries over the flux surface in densities and in the electrostatic potential, and the radial electric field in the plasma edge of tokamaks is presented. Author

N93-21697# Texas Univ., Austin.
MAGNETIC RECONNECTION AND CURRENT-SHEET FORMATION AT x-TYPE NEUTRAL POINTS
R. S. Steinolfson (Southwest Research Inst., San Antonio, TX.), L. Ofman, and P. J. Morrison Oct. 1992 26 p
(Contract DE-FG05-80ET-53088)
(DE93-002161; DOE/ET-53088-577; IFSR-577) Avail: CASI HC A03/MF A01

Numerical solutions of the nonlinear, resistive magnetohydrodynamic

(MHD) equations are used to study the evolution of a perturbed or stressed x-type neutral point. By performing individual simulations for both compressible and incompressible plasmas, we are able to demonstrate that the important physics for this problem involves just the interaction between the plasma flow velocity and the magnetic field and that the thermodynamics has a relatively passive effect. We have also done separate simulations for both solid, conducting wall boundary conditions at a fixed distance from the x-point and for open boundary conditions that adjust as required by the evolving solution within the boundaries. With solid, conducting wall boundary conditions, our solutions for azimuthally symmetric disturbances agree with those obtained in previous analytic linear studies. In this case the stressed x-point relaxes back to the unstressed state on a time scale somewhat shorter than the time scale for the linear resistive tearing mode. Perturbations that are not azimuthally symmetric can relax even faster than the symmetric modes. When the conditions at the boundary are free to adjust, the disturbances grow in amplitude on an Alfven time scale with the eventual formation of a current sheet separating two y-points. This rapid growing behavior is, of course, in sharp contrast to the relatively slow decaying solutions obtained with closed boundaries. The growing solutions qualitatively agree with previous analytic x-point solutions that have been suggested as an explanation for the rapid energy conversion in flares and substorms. DOE

N93-21776# Los Alamos National Lab., NM.
MAGNETICALLY INSULATED ION DIODES FOR SYNTHESIS OF ADVANCED MATERIALS
R. J. Faehl and D. J. Rej 1992 6 p Presented at the 12th International Conference on the Application of Accelerators in Research and Industry, Denton, TX, 2-5 Nov. 1992
(Contract W-7405-eng-36)
(DE93-003747; LA-UR-92-3496; CONF-921116-14) Avail: CASI HC A02/MF A01

Magnetically insulated ion diode technology has been used to generate intense ion beams. We have used such beams to form ablation plasmas from solid targets. Initial experiments have studied congruent deposition of complex stoichiometric thin films. Typical ion diode parameters are 400 kV and 50 kA ion beams over a pulse length of 0.5-1.0 micron. Diode operation has been modeled with 2.5-D particle-in-cell simulations. These calculations allow us to unfold the dynamics of electron flow, ion flow, and their interactions to recover time-dependent impedance behavior which is in good agreement with data. Transport of the dense ion flow through an extraction section of the diode requires a high degree of charge neutralization. Self-consistent neutralization dynamics have been modeled with the simulations. We present the latest numerical results and compare them with data from the ongoing experiments. DOE

N93-21778# Los Alamos National Lab., NM.
PENNING SURFACE-PLASMA SOURCE SCALING LAWS: THEORY AND PRACTICE
H. V. Smith, Jr., P. Allison, and J. D. Sherman 1992 10 p Presented at the Production and Neutralization of Negative Ions and Beams, Upton, NY, 9-13 Nov. 1992
(Contract W-7405-eng-36)
(DE93-003814; LA-UR-92-3664; CONF-921145-1) Avail: CASI HC A02/MF A01

The small-angle source (SAS), 4X source, and 8X source are Penning surface-plasma sources (SPS) that produce high-current, high-brightness H(-) ion beams for accelerator applications. It is desirable to achieve high duty-factor (df) operation, ultimately dc, with a Penning SPS. Two developments may make this goal possible. First, the H(-) beam-emission scaling from the SAS (the 1X device) to the 4X source, and from the 4X source to the 8X source, is more favorable than the scaling laws predict. Second, fringe-field separation of the e(-) and H(-) beams may make it possible to handle the power of the coextracted e(-) beam, especially since a collar arrangement reduces the e(-) loading. We compare our measured results with the predictions of the Penning SPS scaling laws. Particular attention is paid to the H(-) current and temperature scaling as well as the power efficiency. DOE

N93-21809# Georgia Inst. of Tech., Atlanta. Fusion Research Center.
PHYSICS MODELS AND USER'S GUIDE FOR THE NEUTRAL BEAM MODULE OF THE SuperCode
John Mandrekas Aug. 1992 33 p
(PB93-121887; GTFR-102) Avail: CASI HC A03/MF A01

The report contains a description of the neutral beam heating and current drive module beams that was developed at Georgia Tech for the SuperCode, the new systems and operations code for the ITER EDA. The NB module calculates profiles of the neutral beam deposition, fast ion pressure, beam heating power, and neutral beam driven current density. It also computes global parameters such as current drive efficiencies, beam shine through, fast beam ion beta, and the fusion power and neutron production due to beam-plasma interactions. The most important consideration during the development of the module was to make it computationally fast without compromising physical accuracy. The authors believe that through careful selection of physical models and optimized coding, these conflicting requirements have been largely met. As a result, the SuperCode has now the ability to perform self-consistent calculations involving NB heating and current drive. This capability is very important for the study of sub-ignited, hybrid, or steady-state ITER and post-TFTR reactor operating scenarios. It is also the first time that a systems code has had such capabilities, usually found only in 1-1/2D plasma transport codes.
Dissert. Abstr.

N93-21830# Texas Univ., Austin. Inst. for Fusion Studies.
EFFECT OF ALPHA PARTICLES ON TOROIDAL ALFVEN EIGENMODES
H. L. Berk Nov. 1992 21 p
(Contract DE-FG05-80ET-53088)
(DE93-003635; DOE/ET-53088-583; IFSR-583) Avail: CASI HC A03/MF A01

An overview is given of the analytic structure for the linear theory of the Toroidal Alfven Eigenmode (TAE), where multiple gap structures occur. A discussion is given of the alpha particle drive and the various dissipation mechanisms that can stabilize the system. A self-consistent calculation of the TAE mode, for a low-beta high-aspect-ratio plasma, indicates that though the alpha particle drive is comparable to the dissipation mechanisms, overall stability is still achieved for ignited ITER-like plasma. A brief discussion is given of the nonlinear theory for the TAE mode and how nonlinear alpha particle dynamics can be treated by mapping methods. DOE

N93-21837# Los Alamos National Lab., NM.
DENSE PLASMA FOCUS POWERED BY FLUX COMPRESSION GENERATORS
C. M. Fowler, B. L. Freeman, R. S. Caird, D. J. Erickson, and W. B. Garn 1992 13 p Presented at the International Conference on Progress and Applications of Plasma Focus Research, Hoboken, NJ, 27-31 May 1992
(Contract W-7405-eng-36)
(DE93-003781; LA-UR-92-3506; CONF-9105399-1) Avail: CASI HC A03/MF A01

A short summary is given of earlier Los Alamos work in which a Dense Plasma Focus was powered by Flux Compression Generators. Neutron yields obtained in the shot series scaled well with the fifth power of the current. The shot parameters were modeled surprisingly well through the plasma rundown phase by a simple snowplow model. It is shown, with the use of this model, that DPF currents in excess of 10 MA should be obtained with existing generators and initial energy sources. One new element is needed--a high energy opening switch such as a fuse. Much more is known about fuse operation since the Los Alamos program was stopped, so development of this component should be relatively straightforward. If the yield-current scaling relation holds to this current level, then D-T neutron yields in excess of 10(exp 16) per burst would result, sufficient for some interesting pulsed radiography applications that involve rapidly moving components. Finally, in a sheer flight of fancy, it is shown that D-T yields approaching 10(exp 20) could be obtained, using FCG's not too much beyond the state of the art, provided the simple modeling and neutron-current scaling relations continue to hold, a rather unlikely supposition. DOE

N93-21988# Lawrence Livermore National Lab., CA.
SIMULATION MODELS FOR TOKAMAK PLASMAS
A. M. Dimits and B. I. Cohen 2 Oct. 1992 17 p Presented at the International Atomic Energy Agency (IAEA) Technical Committee Meeting on Advances in Simulation and Modeling of Thermonuclear Plasmas, Montreal, Quebec, 15 Jun. 1992

(Contract W-7405-eng-48)
(DE93-002876; UCRL-JC-109895; CONF-9206235-4) Avail: CASI HC A03/MF A01

Two developments in the nonlinear simulation of tokamak plasmas are described. Simulation algorithms that use quasiballooning coordinates were implemented in a 3D fluid code and a 3D partially linearized delta(f) particle code. In quasiballooning coordinates, one of the coordinate directions is closely aligned with that of the magnetic field, allowing both optimal use of the grid resolution for structures highly elongated along the magnetic field as well as implementation of the correct periodicity conditions with no discontinuities in the toroidal direction. Progress on the implementation of a like-particle collision operator suitable for use in partially linearized particle codes is reported. The binary collision approach is shown to be unusable for this purpose. The algorithm under development is a complete version of the test-particle plus source-field approach that was suggested and partially implemented by Xu and Rosenbluth. DOE

N93-21990# Lawrence Livermore National Lab., CA.
WEIBEL INSTABILITIES IN RELATIVISTIC ELECTRON-POSITRON PLASMAS
T.-Y. B. Yang, Y. Gallant, J. Arons (California Univ., Berkeley.), and A. B. Langdon 20 Jul. 1992 8 p Presented at the Physics of Isolated Pulsars Workshop, Taos, NM, 23-28 Feb. 1992
(Contract W-7405-eng-48)
(DE93-003468; UCRL-JC-111252; CONF-9202117-6) Avail: CASI HC A02/MF A01

Wisps have long been observed in the Crab Nebula. Modern observations reveal a whole series of wisps to the northwest, and at least one much fainter wisp to the southeast. Recently, a conceptual model of the wisps in the Crab Nebula has been proposed based on the shock structure of a relativistic magnetosonic shock wave in a electron-positron-proton plasma. The ion overshoot, downstream compressional oscillations, and possibly the pair overshoot can be identified with the wisps. In this paper, we study the linear stability properties of the Weibel instability, which are collective electromagnetic oscillations driven by pitch-angle anisotropy of the distribution functions. This instability can cause pitch-angle scattering of the charged particles and the isotropization of the distribution functions. DOE

N93-21995# Texas Univ., Austin. Inst. for Fusion Studies.
KINETIC THEORY OF TOROIDICITY AND ELLIPTICITY-INDUCED ALFVEN EIGENMODES
R. R. Mett and S. M. Mahajan Oct. 1992 19 p Presented at the Joint Varenna-Lausanne International Workshop on Theory of Fusion Plasmas, Varenna, Italy, 24-28 Aug. 1992
(Contract DE-FG05-80ET-53088)
(DE93-003634; DOE/ET-53088/578; IFSR-578; CONF-920813-2) Avail: CASI HC A03/MF A01

Toroidicity-induced Alfven eigenmodes (TAE) and ellipticity-induced Alfven eigenmodes (EAE) are currently of great interest because they may destroy the confinement of fast ions in a burning tokamak plasma. The present study focuses on kinetic effects, extending the non-perturbative kinetic analysis of the TAE to the EAE. One finds that the parameter which measures the kinetic character of the EAE is significantly smaller than it is for the TAE for elongated plasmas like DIII-D. The parameter is rather small for the lower mode numbers but attains values of order unity or larger for the higher mode numbers, since the parameter scales as the square of the mode number. Consequently, one expects the lower mode number EAE's to have a strongly magnetohydrodynamic (MHD) character, and to suffer only perturbative damping that depends linearly on the dissipative mechanisms. However, while the former is true, the latter is not necessarily the case. This work examines these kinetic T/EAE(KT/EAE) modes in further detail. DOE

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N93-19996# General Electric Co., Gilbert, AZ.
MULTIPLE PROJECTOR SMALL DOME DISPLAY Final Report, Jun. 1991 - Jul. 1992
Diane A. Hughes Dec. 1992 22 p
(Contract F33615-88-C-0001)
(AD-A258621; AL-TP-1992-0057) Avail: CASI HC A03/MF A01

This document describes the Multiple Projector Small Dome Display Project. The goal of this project was to demonstrate the capability of current low-cost liquid crystal display projectors to create a low-cost dome display system. Four such projectors were configured to project on a 10-ft-diameter half-dome. The ability of the image generator to pre-correct the image for the distortion of the curved projection surface was essential since the projectors offered no raster adjustments. As configured for this project, the four projectors provided a field of view of 70 degrees horizontal by 45 degrees vertical. Performance of the display provided better than 6 arc minutes per pixel resolution, brightness of 4 foot-lamberts and a contrast ratio of 28 to 1. GRA

N93-20027# Department of the Navy, Washington, DC.
ORIENTED, SINGLE-PHASE THIN FILMS OF POTASSIUM TANTALATE-NIOBATE Patent Application
Azar Nazari, inventor (to Navy) and Manfred Kahn, inventor (to Navy) 25 Sep. 1992 44 p
(AD-D015543; US-Patent-Appl-SN-950558; Navy-Case-73175) Avail: CASI HC A03/MF A01

An oriented, essentially single phase perovskite film of potassium tantalate-niobate is formed. Preferred substrate surfaces for deposition include SrTiO3 (110) and (100) and MgO (100). Films formed on SrTiO3 (110) and (100) are epitaxial. The films are formed by applying a solution of an organometallic complex of tantalum, potassium, and niobium onto a substrate surface. The deposited solution is dried and organics removed by heating. The thus formed film is then transferred to an oven preheated to a temperature of between about 700 C and 750 C. After cooling, further layers of single phase, oriented potassium tantalate-niobate may be deposited by repeating the same procedures. The deposited films can form a useful device for microelectronics and electro-optics.
Author (GRA)

N93-20037*# Rensselaer Polytechnic Inst., Troy, NY. Physics Dept.
THEORY OF GRAIN ALIGNMENT IN MOLECULAR CLOUDS Annual Status Report, 1 May 1992 - 28 Feb. 1993
Wayne G. Roberge 23 Feb. 1993 64 p
(Grant NAGw-3001)
(NASA-CR-192307; NAS 1.26:192307) Avail: CASI HC A04/MF A01

Research accomplishments are presented and include the following: (1) mathematical theory of grain alignment; (2) super-paramagnetic alignment of molecular cloud grains; and (3) theory of grain alignment by ambipolar diffusion. Derived from text

N93-20055# Rice Univ., Houston, TX. Dept. of Chemistry.
LOW-PRESSURE DIAMOND GROWTH USING A SECONDARY RADICAL SOURCE
Tertu I. Hukka, Robin E. Rawles, and Mark P. DEvelyn 11 Dec. 1992 8 p
(Contract N00014-91-J-1550)
(AD-A258539; TR-15) Avail: CASI HC A02/MF A01

A method for chemical vapor deposition and atomic layer epitaxy using radical precursors under medium vacuum conditions is being developed. Fluorine atoms are generated by thermal dissociation in a hot tube and abstract hydrogen atoms from precursor molecules injected immediately downstream of the source, generating radicals with complete chemical specificity. The radical precursors are then transported to the growing substrate surface under nearly collision-free conditions. To date we have grown diamond films from CCl3 or CH3 radicals together with atomic hydrogen, generated by injecting CHCl3 or CH4 and H2 into the F atom stream at reactor pressures between 10(exp -4) and 10(exp -2) Torr.

This approach should be ideal for low-temperature growth and atomic layer epitaxy: growth rates remain relatively high because activation energies for radical reactions are typically small and because the cycle times for atomic layer epitaxy can be reduced to the msec range by fast gas-stream switching, and contamination and segregation are minimized by keeping the surface 'capped' by chemisorbed intermediates. GRA

N93-20056# Advanced Technology Materials, Inc., Danbury, CT.
CONTROLLED NUCLEATION AND GROWTH OF SEMICONDUCTING DIAMOND Final Report, 12 Jun. 1990 - 1 Jan. 1991
C. P. Beetz, Jr. and Bo-Yang Lin 18 Dec. 1992 22 p
(Contract N00014-90-C-0139)
(AD-A258541) Avail: CASI HC A03/MF A01

UHV surface analysis measurements of film growth were coupled with novel precursor chemistry to study the effect of precursor chemical structure on the efficiency of diamond film nucleation and growth. The goal is to optimize source gases and substrate surface preparation methods for both doped and undoped diamond film nucleation and growth, enabling the use of diamond in field emission, semiconductor, and optoelectronic applications. 'Surface perfection' of the diamond substrate was found to be a crucial factor in CVD of sp2-free diamond deposition. Exposure of a diamond 100 surface to CO at high temperature (900 C) resulted in propagation of the diamond surface and extreme smoothing as monitored by RHEED. Growth was apparently linked to an inadvertent impurity, iron, which may have catalyzed the decomposition of CO. Improved nucleation and growth rates from non-hydrogen-containing carbon sources may be achievable with catalysis by transition metals. We intend to use this discovery in Phase 2 to develop diamond emitters for flat panel displays, UHV analytical instruments, and microwave vacuum electronics. GRA

N93-20127*# Alabama A & M Univ., Normal.
[A STUDY OF TRIGLYCINE SULFATE (TGS) CRYSTALS FROM THE INTERNATIONAL MICROGRAVITY LABORATORY MISSION (IML-1)] Monthly Technical Report, 1 Mar. - 31 Aug. 1992
R. B. Lal 31 Aug. 1992 52 p
(Contract NAS8-36634)
(NASA-CR-191956; NAS 1.26:191956) Avail: CASI HC A04/MF A01

Preliminary evaluation of the data was made during the hologram processing procedure. A few representative holograms were selected and reconstructed in the HGS; photographs of sample particle images were made to illustrate the resolution of all three particle sizes. Based on these evaluations slight modifications were requested in the hologram processing procedure to optimize the hologram exposure in the vicinity of the crystal. Preliminary looks at the data showed that we are able to see and track all three sizes of particles throughout the chamber. Because of the vast amount of data available in the holograms, it was recommended that we produce a detailed data reduction plan with prioritization on the different types of data which can be extracted from the holograms. Author

N93-20131# North Carolina State Univ., Raleigh.
INTERFACE PROPERTIES OF WIDE BANDGAP SEMICONDUCTOR STRUCTURES Annual Report, 19 Feb. - 31 Dec. 1992
Robert F. Davis Dec. 1992 123 p
(Contract N00014-92-J-1477)
(AD-A259416) Avail: CASI HC A06/MF A02

Theoretical computations using the Car-Parrinello version of quantum molecular dynamics is being used to study the structure, bonding, and reactions of various C-, Cl-, and H-containing species on the diamond surface, particularly as they pertain to the ALE of diamond. Related studies are also focused on the potential for particular elements to be donor and acceptor species in GaN and AlN. The interfacial aspects of diamond growth and the negative electron affinity on the (111) surface have been extensively investigated. Computer-controlled synthesis of diamond has been achieved using an oxy-C2H2 torch. Two-dimensional growth was achieved. Epitaxial films of cubic Beta(3C)-SiC(111) and AlN(0001) have been deposited on alpha(6H)-SiC(0001) substrates oriented 3-4 deg towards (1120) at 1050 C via gas-source MBE using Si2H6, C2H4, thermal evaporation of Al, and activated N species from an ECR plasma. HRTEM revealed that the nucleation and growth of the Beta(3C)-SiC regions occurred primarily on terraces between closely spaced steps. Pseudomorphic bilayer structures containing Beta(3C)-SiC and 2H-AlN have been grown under the same conditions for the first time. Epitaxial GaP and GaN films have also been achieved via GSMBE at 200 C and ALE at 635 C, respectively. Rectifying contacts of SiGe alloys and Ti, Pt, and Hf have been deposited and characterized on diamond (100) and alpha(6H)-SiC(0001), respectively. GRA

N93-20236*# Alabama Univ., Huntsville. Center for Microgravity and Materials Research.
PROCESS MODELLING FOR MATERIALS PREPARATION EXPERIMENTS Semiannual Progress Report No. 7, 1 Aug. 1992 - 31 Jan. 1993
Franz Rosenberger and J. Iwan D. Alexander 31 Jan. 1993 34 p
(Grant NAG8-790)
(NASA-CR-192319; NAS 1.26:192319) Avail: CASI HC A03/MF A01

The main goals of the research under this grant consist of the development of mathematical tools and measurement of transport properties necessary for high fidelity modeling of crystal growth from the melt and solution, in particular, for the Bridgman-Stockbarger growth of mercury cadmium telluride (MCT) and the solution growth of triglycine sulphate (TGS). Of the tasks described in detail in the original proposal, two remain to be worked on: (1) development of a spectral code for moving boundary problems; and (2) diffusivity measurements on concentrated and supersaturated TGS solutions. Progress made during this seventh half-year period is reported. Derived from text

N93-20274# Minnesota Univ., Minneapolis. Dept. of Chemical Engineering and Materials Science.
CLUSTER FORMATION AND EVOLUTION ON SEMICONDUCTOR SURFACE Final Report, 1 Oct. 1989 - 30 Sep. 1992
J. H. Weaver 15 Dec. 1992 13 p
(Contract N00014-90-J-1190)
(AD-A259190) Avail: CASI HC A02/MF A01

This program focused on fundamental problems related to the nucleation and growth of clusters and the interaction of those clusters with surfaces. The issues it addressed were those involved with the deposition of atoms on a surface, particularly the chemical environments created by those atoms and the processes encountered as the number of atoms increases. It investigated cluster formation and cluster-induced reaction, as well as the tendency of clusters to nucleate preferentially at particular defect sites of the surface. It focused on the evolution of clusters into new structures with distinct crystalline character. These issues are of very broad importance because they are encountered when considering the growth of elemental and compound layers on any surface, be they semiconductors, high temperature superconductors, or fullerides. GRA

N93-20287 State Univ. of New York, Stony Brook.
ATOMIC AND ELECTRONIC STRUCTURE OF ULTRATHIN FILMS Ph.D. Thesis
Di Tian 1992 215 p
Avail: Univ. Microfilms Order No. DA9232810

The most important result of this work is the establishment of low-energy electron diffraction (LEED) as a reliable quantitative technique for experimental studies of ultrathin films, i.e., films with thicknesses ranging from less than 1 to a few tens of atomic layers, and in particular for the determination of the growth mode and the atomic structure of such films. The experiments were focussed on films of metals on metallic substrates, and special attention was devoted, in view of the widespread interest in monolayer magnetism, to films of both body-centered-cubic (BCC) and face-centered cubic (FCC) iron and of FCC manganese on low-index surfaces of nickel, copper, ruthenium, palladium and silver. It was found that metastable FCC iron could indeed be grown epitaxially on (001) surfaces of copper and nickel, but on all other substrates tested in this work only the stable BCC phase of iron could be grown. Layer-by-layer growth of iron was not found to occur on any substrate, in contrast to several literature reports, and Stranski-Krastanov growth was reliably detected only on the basal plane of ruthenium. Ultrathin films of manganese with the metastable FCC structure were found to be relatively easy to grow on several FCC substrates, and a new phase with as-yet unknown crystal structure was found to be formed on Pd(111) and Cu(111). With non-magnetic materials the most noteworthy results concern the epitaxial growth of copper in the form of highly-strained tetragonally-distorted films on Pd(001) and of incommensurate films on Pd(111). The inversion of this epitaxial system, i.e., deposition of palladium on Cu(001), produced a surface alloy with the

Cu3Au structure. The work presented herein includes also the use of LEED in its traditional mode of quantitative intensity analysis for the purpose of characterizing the atomic structure of the clean surfaces which were used as substrates in the epitaxial experiments. Attention was also devoted to the study of the electronic properties of copper and silver by means of photoemission experiments carried out at the National Synchrotron Light Source. Dissert. Abstr.

N93-20311*# Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
THIN FILM PROCESSING OF PHOTOREFRACTIVE BaTiO3 Annual Progress Report
Paul R. Schuster Jan. 1993 83 p Original contains color illustrations
(Grant NAG1-1247)
(NASA-CR-192169; NAS 1.26:192169) Avail: CASI HC A05/MF A01; 11 functional color pages

During the period covered by this report, October 11, 1991 through October 10, 1992, the research has progressed in a number of different areas. The sol-gel technique was initially studied and experimentally evaluated for depositing films of BaTiO3. The difficulties with the precursors and the poor quality of the films deposited lead to the investigation of pulsed laser deposition as an alternative approach. The development of the pulsed laser deposition technique has resulted in continuous improvements to the quality of deposited films of BaTiO3. The initial depositions of BaTiO3 resulted in amorphous films, however, as the pulsed laser deposition technique continued to evolve, films were deposited in the polycrystalline state, then the textured polycrystalline state, and most recently heteroepitaxial films have also been successfully deposited on cubic (100) oriented SrTiO3 substrates. A technique for poling samples at room temperature and in air is also undergoing development with some very preliminary but positive results. The analytical techniques, which include x-ray diffraction, ferroelectric analysis, UV-Vis spectrophotometry, scanning electron microscopy with x-ray compositional analysis, optical and polarized light microscopy, and surface profilometry have been enhanced to allow for more detailed evaluation of the samples. In the area of optical characterization, a pulsed Nd:YAG laser has been incorporated into the experimental configuration. Now data can also be acquired within various temporal domains resulting in more detailed information on the optical response of the samples and on their photorefractive sensitivity. The recent establishment of collaborative efforts with two departments at Johns Hopkins University and the Army Research Lab at Fort Belvoir has also produced preliminary results using the metallo-organic decomposition technique as an alternative method for thin film processing of BaTiO3. RF and DC sputtering is another film deposition approach that should be initiated in the near future. Other techniques for optical characterization, which may even allow for intragrannular (within single grains) investigations, are also being considered. Derived from text

N93-20367# Boston Univ., MA. Dept. of Electrical Computer and Systems Engineering.
GROWTH AND DOPING OF Al(x)Ga(1-x) FILMS BY ELECTRON CYCLOTRON RESONANCE ASSISTED MOLECULAR BEAM EPITAXY Semiannual Report
Theodore Moustakas 30 Oct. 1992 91 p
(Contract N00014-92-J-1436)
(AD-A258722) Avail: CASI HC A05/MF A01

Growth and doping of GaN by ECR assisted MBE is reported. We report on the role of the GaN-buffer and AlN-buffer, and their combination on the two dimensional nucleation rate and lateral growth rate. Conditions for quasi layer by layer growth were identified. XRD was used to study secondary phase, the direction and quality of orientational ordering in and out of the substrate, and homogeneous and inhomogeneous strain.' Relatively high mobility autodoped films were produced and their transport mechanism was investigated. Intrinsic GaN films were produced and were doped n- and p- type with Si and Mg respectively, without requiring annealing for dopant activation. RIE processing of GaN was developed and metal contacts were investigated. A direct correlation between the metal work function and barrier height was also found. GRA

N93-20404# Texas Univ., Austin.
QUANTUM DYNAMICS OF SHOCK WAVES IN MOLECULAR CRYSTALS
30 Sep. 1992 4 p
(Contract N00014-89-J-1379)
(AD-A258749) Avail: CASI HC A01/MF A01

This research has focused upon theoretical studies of shock wave transport in model molecular lattices via both classical and quantal techniques. In the previous grant period, the cluster model was developed and applied to model harmonic and cubic anharmonic molecular lattices. During this grant period, the cluster method has been extended to three more complex and physically significant situations. These are: (1) shock wave propagation in a linear chain of Morse oscillators; (2) shock wave propagation in a linear NCCN lattice with Morse interaction potentials; (3) shock wave propagation in a 2D model CH3NO2 lattice. During this grant period, the semiclassical cluster model was applied to three lattice models of increasing complexity. In the first study, which has been published in J. Phys. Condens. Matter, a lattice od diatomic molecules was considered. All interatomic interactions were described by Morse potentials. GRA

N93-20407# North Carolina State Univ., Raleigh. Dept. of Materials Science and Engineering.
GROWTH, CHARACTERIZATION AND DEVICE DEVELOPMENT IN MONOCRYSTALLINE DIAMOND FILMS Annual Letter Report, 1 Jan. - 31 Dec. 1992
Robert F. Davis Dec. 1992 64 p
(Contract N00014-90-J-1604)
(AD-A259099) Avail: CASI HC A04/MF A01

Investigations concerned with bias-enhanced nucleation (BEN) of diamond films revealed that the substrate holder must be diamond coated to achieve this phenomenon. This suggests that some unique property of diamond is responsible for the increased nucleation densities. The carbide-forming substrates tended to nucleate more rapidly than other substrates, thus indicating that the carbide forming nature of the substrate may play an important role. A statistical experimental design was implemented to optimize the process parameters associated with BEN. Continued efforts regarding the surface and interface properties of diamond showed an increased density of impurity-related defects during the initial stages of growth. Angle resolved photo-emission revealed a negative electron affinity (NEA) on diamond(111) after cleaning and after sub-monolayer deposition of Ti. The Schottky barrier height of Ti on diamond was also measured. A model is proposed for the observed NEA. The device modeling research on MESFET's was expanded to include MOSFET's and JFET's. The NCSU large-signal FET model was augmented with simulations using Stanford's Pisces IIB simulator. An interface program was written to couple the NCSU and Stanford models and used to investigate the dc performance of three diamond FET's. Good agreement between measured and simulated data was obtained. GRA

N93-20561# North Carolina State Univ., Raleigh.
PSEUDOMORPHIC SEMICONDUCTING HETEROSTRUCTURES FROM COMBINATIONS OF AlN, GaN AND SELECTED SiC POLYTYPES: THEORETICAL ADVANCEMENT AND ITS COORDINATION WITH EXPERIMENTAL STUDIES OF NUCLEATION, GROWTH, CHARACTERIZATION AND DEVICE DEVELOPMENT Annual Report, 1 Jan. - 31 Dec. 1992
Robert F. Davis Dec. 1992 66 p
(Contract N00014-90-J-1427)
(AD-A259177) Avail: CASI HC A04/MF A01

Pseudomorphic bilayer structures containing Beta(3C)-SiC and 2H-AlN have been grown for the first time on vicinal alpha(6H)-SiC(0001) homoepitaxial layers at 1050 C by plasma-assisted, gas source molecular beam epitaxy. High energy electron diffraction and cross-sectional high-resolution transmission electron microscopy showed all layers to be monocrystalline. The AlN layers were uniform in thickness. Defects in these layers were initiated at steps on the 6H-SiC film. Pseudomorphic layers of GaN have also been deposited on thin films of AlN grown on a(6H)-SiC(0001) and sapphire(0001). This was achieved by preventing the formation of a thin amorphous layer on both substrates via reaction with the active N species from the ECR plasma source. The p-type and n-type doping of GaN during deposition with Mg and Si, respectively, has also been achieved for the first time. The resistivity, Hall mobility and carrier concentration of the p-type material were 0.5 ohm-cm, 10 sq cm/V-s and 1 x 10(exp 18) cm(exp -3), respectively. Layers of cubic-BN have been achieved on Si(100) and diamond(100); however, they were occurred as a final step in a sequence; wherein, the prior layers consisted of a-BN and h-BN. GRA

N93-20581# North Carolina State Univ., Raleigh.
LOW TEMPERATURE DEPOSITION AND CHARACTERIZATION OF N- AND P-TYPE SILICON CARBIDE THIN FILMS AND ASSOCIATED OHMIC AND SCHOTTKY CONTACTS Annual Report, 1 Jan. - 31 Dec. 1992
R. F. Davis, R. J. Nemanich, R. S. Kern, R. Patterson, and L. B. Rowland Jan. 1992 65 p
(Contract N00014-92-J-1500)
(AD-A259247) Avail: CASI HC A04/MF A01

Single-crystal epitaxial films of cubic Beta(3C)-SiC(111) and AlN(0001) have been deposited on alpha(6H)-SiC(OOO1) substrates oriented 3-4 deg towards zone axes 1120 at 1050 C via gas-source molecular beam epitaxy using disilane (Si2H6), ethylene (C2H4), thermal evaporation of Al, and activated N species derived from an ECR plasma. High resolution transmission electron microscopy revealed that the nucleation and growth of the Beta(3C)-SiC regions occurred primarily on terraces between closely spaced steps. Pseudomorphic bilayer structures containing Beta(3C)-SiC and 2H-AlN have been grown under the same conditions for the first time. HREED and cross-sectional HRTEM showed all layers to be monocrystalline. Initial high temperature chemical interdiffusion studies between SiC and AlN show that all components diffuse very slowly across the interface. AHRTEM and SAS are being used to determine the concentration profiles. Thin film solid solutions of AlN and SiC have been deposited using similar techniques and conditions as the individual compounds. Metal contacts of Ti, Pt, and Hf deposited at RT on n-type alpha(6H)-SiC(OOO1) exhibit rectifying behavior with ideality factors between 1.01 and 1.09. The Pt and Hf contacts had leakage currents of 5 x 10(exp -8) A/sq cm at -10 V. Values of barrier heights for all contacts were within a few tenths of 1.0 eV which is indicative that the Fermi level is pinned at the SiC surface. GRA

N93-20598# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
THE EFFECT OF OXIDE LAYERS AND BORON DOPING ON THE BREAKDOWN OF HIGH PURITY SILICON M.S. Thesis
Brian A. Hibbeln 1 Dec. 1992 65 p
(AD-A259171; AFIT/GEP/ENP/92D-5) Avail: CASI HC A04/MF A01

For many applications such as lasers and radar drive circuits, there exists a need for solid state, high voltage, high current switches. Current gaseous discharge switches fail to satisfy the ruggedness, reliability, and lifetime requirements of today's systems. A promising alternative is the Photoconductive Semiconductor Switch (PCSS). The limiting factor in the operation of these switches is the occurrence of breakdown through channels formed slightly below the surface. A theory on the formation of these channels is presented based upon band bending at the metal-semiconductor interface, a nonhomogeneous space charge due to irregular trap distributions, and thermal runaway in localized regions. Experimental results on the effect of thin oxide layers and boron doping at the metal-semiconductor junctions reveal that the junctions play a very important role in the breakdown of the samples, changing the breakdown potential by almost a factor of three. By placing a thin oxide layer at the anode face of a sample, an excellent photoconductive switch can be produced. The resistance of this switch was changed by three orders of magnitude through optical illumination. GRA

N93-20777 Department of the Navy, Washington, DC.
METHOD OF PRODUCING Bi-Sr-Ca-Cu-O SUPERCONDUCTING MATERIALS IN CAST FORM Patent
Virgil Provenzano, inventor (to Navy), Anand K. Singh, inventor (to Navy), M. A. Imam, inventor (to Navy), Kuntimadi Sadananda, inventor (to Navy), and William F. Henshaw, inventor (to Navy) 29 Sep. 1992 6 p Filed 28 Feb. 1990 Supersedes N91-19917 (29 - 11, p 1806), AD-D014656
(AD-D015532; US-Patent-5,131,407; US-Patent-Appl-SN-489313; US-Patent-Class-505-1) Avail: US Patent and Trademark Office

Bulk form of superconducting materials are produced by pouring a melt of O2-containing superconducting material into a heated mold, cooling the mold until solidification begins, removing the cast object from the mold, gradually cooling the cast object to prevent the development of thermal stresses, and then annealing the cast cooled object to restore O2 to near equilibrium levels. The bulk form produced according to the present invention may be used as a sputtering target in the production of wires, or as a bulk form semiconductor. GRA

N93-20842# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).
DEFECTS AND IMPURITIES IN AMORPHOUS SEMICONDUCTORS AND IN LIQUID ELECTROLYTES
Gerhard Mueller and Gerhard Kroetz 1992 8 p Repr. from Applied Physics A, v. 54, 1992 p 40-46
(MBB-Z-0386-91-PUB; ETN-92-92753) Avail: CASI HC A02/MF A01

Amorphous (a-) semiconductors like a-Si:H and the chalcogenide glasses possess a general tendency to establish an overall equilibrium between the electronic system and the lattice with its dopant and defect sites. The chemical interactions which establish these equilibria within the bulk of the a-semiconductor lattices are compared to chemical interactions in liquid electrolytes, particularly to those in H2O. These considerations reveal close similarities between autocompensation doping in a-semiconductors and acid/base reactions in H2O. The effects of light and field effect induced defect formation, on the other hand, are shown to be related to the phenomenon of electrolysis in H2O. The consideration of these analogies further emphasizes the roles of charge carrier localization and that of H diffusion in promoting dopant and defect equilibrium reactions in a-semiconductors. ESA

N93-21224# Corporation for Studies and Analysis, Inglewood, CA.
DEVELOPMENT OF SUPERCONDUCTING THIN FILMS WITH A CRITICAL TEMPERATURE GREATER THAN 110 K Final Report, Mar. 1989 - Oct. 1990
Ned Ianno Dec. 1991 48 p
(Contract F19628-89-C-0090)
(AD-A257988; RL-TR-91-314) Avail: CASI HC A03/MF A01

CSA provided superconducting thin films consisting of Tl2Ca1Ba2Cu2O(x) on LaAlO3. Films were generated using the pulsed laser deposition (PLD) method. The company achieved a zero resistance temperature of 115 K and a critical current density of 1,000,000 A/sq cm at 77 K. Relationships between the deposition process, the as-deposited film, annealing conditions, and the annealed film were investigated. Twenty thallium-based high temperature superconducting films on microwave compatible substrates were delivered under provisions of this contract. GRA

N93-21240# Oak Ridge National Lab., TN.
FAST NEUTRON-INDUCED CHANGES IN NET IMPURITY CONCENTRATION OF HIGH-RESISTIVITY SILICON
I. Tsveybak (Tennessee Univ., Knoxville.), W. Bugg (Tennessee Univ., Knoxville.), J. A. Harvey, and J. Walter (IntraSpec, Inc., Oak Ridge, TN.) 1992 10 p Presented at the Nuclear and Space Radiation Effects Conference, New Orleans, LA, 13-17 Jul. 1992
(Contracts DE-AC05-84OR-21400; DE-FG05-91ER-40627)
(DE93-003104; CONF-920716-9) Avail: CASI HC A02/MF A01

Resistivity changes produced by 1 MeV neutron irradiation at room temperature have been measured in float-zone grown n and p-type silicon with initial resistivities ranging from 1.8 to 100 k-ohms(cm). Observed changes are discussed in terms of net electrically active impurity concentration. A model is presented which postulates escape of Si self-interstitials and vacancies from damage clusters and their subsequent interaction with impurities and other pre-existing defects in the lattice. These interactions lead to transfer of B and P from electrically active substitutional configurations into electrically inactive positions (B(sub i), Pi(sub i), and E-center), resulting in changes of net electrically active impurity concentration. The changes in spatial distribution of resistivity are discussed, and the experimental data are fit by theoretical curves. Differences in the behavior of n-type and p-type material are explained on the basis of a faster removal of substitutional P and a more nonuniform spatial distribution of the original P concentration. DOE

N93-21241# Air Force Inst. of Tech., Wright-Patterson AFB, OH. Foreign Aerospace Science and Technology Center.
GaAs COMPUTER TECHNOLOGY
Qiao-Yu Wang 7 Jan. 1992 10 p Transl. into ENGLISH from Weidianzi Xueyu Jisuanji (China), v. 8, no. 6, 1991 p 43-47
(AD-A259259; FASTC-ID(RS)T-0310-92) Avail: CASI HC A02/MF A01

The paper presents development on GaAs computers and an approach to designing GaAs computers. GRA

N93-21403# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).
RELAXATION OF RADIATION DAMAGES IN a-Si:H LAYERS Abstract Only [RELAXATION VON STRAHLENSCHAEDEN IN A-SI:H SCHICHTEN]
H. Stitzl, Gerhard Kroetz, and Gerhard Mueller 1990 2 p In GERMAN Presented at the 8th Honnefer Gespraech Amorphe Halbleiter, Bad Honnel, Germany, 17-19 Oct. 1990
(MBB-Z-0317-90-PUB; ETN-93-93443) Avail: CASI HC A01/MF A01

The irradiation of a-Si:H fibers with electrons, protons, and a series of heavy ions was carried out, and the relaxation of resulting radiation damages was examined under isothermal conditions, using conduction and photoconduction measurements. It was found that constant radiation doped specimens, in particular boron doped, annealed more rapidly than undoped and compensated specimens. For strong specimen doping, an increase of activation energy was observed, in relation with increasing radiation dosage. ESA

N93-21464# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany).
BIAS-ANNEALING EXPERIMENTS FOR DOPED a-Si:H LAYERS Abstract Only [BIAS-ANNEALING EXPERIMENTE AN DOTIERTEN A-SI:H SCHICTEN]
Gerhard Kroetz, Joerg Wind, and Gerhard Mueller 1990 3 p In GERMAN Presented at 8th Honnefer Gespraech Amorphe Halbleiter, Bad Honnef, Germany, 17-19 Oct. 1990
(MBB-Z-0316-90-PUB; ETN-93-93442) Avail: CASI HC A01/MF A01

The layers which were separated in field effect arrangement were characterized, using transport and optical measurements. Thermal oxidized high doped c-Si was used as a substrate and as a gate electrode. It was found that, after recovery with charge carrier depletion, very high conducting conditions were frozen, and that, after recovery with charge carrier enrichment, low conducting conditions were frozen. These effects were very high for n-material, whereas they were much lower for p-material. ESA

N93-21486# Sandia National Labs., Albuquerque, NM.
DIFFRACTION PEAKS IN X RAY SPECTROSCOPY: FRIEND OR FOE?
R. G. Tissot and R. P. Goehner 1992 8 p Presented at the Annual Denver X Ray Conference, Denver, CO, 3-7 Aug. 1992
(Contract DE-AC04-76DP-00789)
(DE93-002482; SAND-92-2079C; CONF-9208129-6) Avail: CASI HC A02/MF A01

Diffraction peaks can occur as unidentifiable peaks in the energy spectrum of an x-ray spectrometric analysis. Recently, there has been increased interest in oriented polycrystalline films and epitaxial films on single crystal substrates for electronic applications. Since these materials diffract x-rays more efficiently than randomly oriented polycrystalline materials, diffraction peaks are being observed more frequently in x-ray fluorescent spectra. In addition, micro x-ray spectrometric analysis utilizes a small, intense, collimated x-ray beam that can yield well defined diffraction peaks. In some cases these diffraction peaks can occur at the same position as elemental peaks. These diffraction peaks, although a possible problem in qualitative and quantitative elemental analysis, can give very useful information about the crystallographic structure and orientation of the material being analyzed. The observed diffraction peaks are dependent on the geometry of the x-ray spectrometer, the degree of collimation, and the distribution of wavelengths (energies) originating from the x-ray tube and striking the sample. DOE

N93-21489# California Univ., Berkeley. Lawrence Berkeley Lab.
OXYGEN CONFIGURATIONS AND THEIR EFFECT ON CHARGE TRANSFER IN YBa2Cu3O(z)
R. McCormack, D. deFontaine, and G. Ceder (Massachusetts Inst. of Tech., Cambridge.) Apr. 1992 7 p Presented at the 1992 Material Research Society (MRS) Spring Meeting, San Francisco, CA, 27 Apr. - 2 May 1992
(Contract DE-AC03-76SF-00098)
(DE93-002543; LBL-32828; CONF-920402-61) Avail: CASI HC A02/MF A01

The relationship between oxygen structure, charge transfer (hole count), and oxygen content in the YBa2Cu3Oz superconductor is studied by combining Monte-Carlo simulation with existing electronic structure calculations. The present model proposed an expansion of the hole count in terms of oxygen configuration variables for states of an arbitrary degree of order. Calculations of hole count as a function of oxygen content suggest that oxygen ordering is, at least in part, responsible for the observed plateau structure of T(sub c) vs. oxygen content z. DOE

N93-21701# Louisiana State Univ., Baton Rouge. Dept. of Physics and Astronomy.
VACUUM STRUCTURE OF PURE GAUGE THEORIES ON THE LATTICE
R. W. Haymaker, V. Singh, D. Browne, and J. Wosiek (Jagellonian Univ., Cracow, Poland.) 1992 14 p Presented at the Workshop on QCD Vacuum Structure, Paris, France, 1-5 Jun. 1992
(Contract DE-FG05-91ER-40617)
(DE93-001920; DOE/ER-40617/129; CONF-9206280-3) Avail: CASI HC A03/MF A01

Results from simulations on two aspects of quark confinement in the pure gage sector are presented. First is the calculation of the profile of the flux tube connecting a static q(bar q) pair in SU(2). By use of the Michael sum rules as a constraint, evidence is set forth that the energy density at the center of the flux tube goes to a constant as a function of quark separation. Slow variation of the width and energy density is not ruled out. Secondly in the confined phase of lattice U(1), the curl of the magnetic monopole current is calculated, and it is shown that the dual London equation is satisfied and that the electric fluxoid is quantized. DOE

N93-21710# Carnegie-Mellon Univ., Pittsburgh, PA.
THE ROLE OF MICROSTRUCTURAL PHENOMENA IN MAGNETIC THIN FILMS
D. E. Laughlin and D. N. Lambeth 1992 31 p
(Contract DE-FG02-90ER-45423)
(DE93-005132; DOE/ER-45423/3) Avail: CASI HC A03/MF A01

Magnetic recording media is studied. Results during the first 2 years are presented under the following headings: atomic resolution transmission electron microscopy (TEM) of CoNiCr films; CoNiCr and CoCrTa thin films; development of texture; and CoSm/Cr thin films. The high resolution electron microscopy (HREM) results showed that defects in Co-based films may be responsible for higher coercivity. Findings are presented on the effects of Cr interlayers on the microstructure of the second Co-based film in Co/Cr/Co/Cr multilayer films. Proposed research plans are outlined. DOE

N93-21712# Pennsylvania Univ., Philadelphia.
THE ROLES OF SLIP GEOMETRY AND HARDENING BEHAVIOR IN INTERGRANULAR TOUGHNESS
C. Laird and J. Bassani Sep. 1992 30 p
(Contract DE-FG02-85ER-45188)
(DE93-005647; DOE/ER-45188/8) Avail: CASI HC A03/MF A01

Research is reported in the following areas: cyclic response of polycrystalline Cu, bicrystal experiments and boundary theory, interfacial discontinuities, shear localization in single crystals, coarse slip bands, and macroscopic shear bands. DOE

N93-21719# Argonne National Lab., IL.
NEUTRON STUDY OF CRYSTAL-FIELD TRANSITIONS IN ErPO4
C.-K. Loong, L. Soderholm, J. P. Hammonds, M. M. Abraham, L. A. Boatner, and N. M. Edelstein 1992 13 p Presented at the Conference on Magnetism and Magnetic Materials, Houston, TX, 1-4 Dec. 1992
(Contract W-31-109-eng-38)
(DE93-004131; ANL/CP-76341; CONF-921201-8) Avail: CASI HC A03/MF A01

The crystal-field splitting of the Er(sup 3+) ground multiplet, (sup 4)I(sub 15/2), in ErPO4 is investigated by inelastic neutron scattering. Four excitations from the Gamma(sub 7) ground state to the excited states and several transitions between the excited states have been identified. The observed transition energies and intensities are used to refine the parameters of the crystal-field potential. The calculated magnetic susceptibility, chi(T), agrees well with experimental values from single-crystal measurements. A comparison of the neutron data with optical absorption and both nonresonance and resonance Raman scattering measurements has been made. DOE

N93-21738# Los Alamos National Lab., NM.
INTERFACIAL STRUCTURE OF Si3N4 BRAZED WITH AN Ag-Cu-Ti ALLOY

H. Suematsu, J. J. Petrovic, T. E. Mitchell, and T. Yano (Tokyo Inst. of Tech., Japan.) 1992 11 p Presented at the Ceramic Science and Technology Congress and Exposition, San Francisco, CA, 1-4 Nov. 1992
(Contract W-7405-eng-36)
(DE93-003777; LA-UR-92-3702; CONF-921128-4) Avail: CASI HC A03/MF A01

Single crystal Si3N4 was brazed using a Ag-Cu eutectic alloy containing 2 percent Ti at 950 C for 30 min and the interface was observed by high resolution electron microscopy. A layer of reaction products is formed between the Si3N4 and the brazed metal. TiN and Ti2N are formed near the interface; however, only TiN is found at the interface in contact with the Si3N4. A crystallographic orientation relationship was found between the TiN and Si3N4 in which the N atoms are shared between the two structures with little distortion. DOE

N93-21750# Oak Ridge National Lab., TN.
PROPERTIES OF ALIGNED YBa2Cu3O(7-DELTA) SUPERCONDUCTOR AS A FUNCTION OF OXYGEN DEFICIENCY DELTA
J. G. Ossandon (Talca Univ., Chile) and J. R. Thompson 1992 10 p Presented at the 3rd International Conference and Exhibition of the World Congress on Superconductivity, Munich, Germany, 14-19 Sep. 1992 Submitted for publication
(Contract DE-AC05-84OR-21400)
(DE93-001707; CONF-920916-2) Avail: CASI HC A02/MF A01

Systematic studies of flux pinning and intragrain critical current J(sub c) were conducted in magnetically aligned, sintered Y1Ba2Cu3O(7-delta) material as a function of oxygen deficiency delta in the range 0 approximately 0.2. The essential findings are: (1) maximum J(sub c) occurred at full oxygenation, i.e., J(sub c) and pinning decreased steadily as oxygen was removed; (2) the irreversibility line B(sub irr)(T,delta) was degraded with the introduction of oxygen defects; (3) this degradation was strongly correlated with the reduction of J(sub c)(delta), implying that the irreversibility line is determined by the strength of the flux pinning defects; (4) the condensation energy F(sub c) decreased significantly with delta, indicating a rapid weakening in the effectiveness of pre-existing pinning centers; (5) both lambda and xi increased as oxygen was removed, while (6) their ratio kappa and the superconductive anisotropy parameter gamma = (lambda(sub c)/(lambda(sub ab)) approx 5 varied little for delta less than or equal to 0.2. DOE

N93-21752# Argonne National Lab., IL.
MANY-BODY EFFECTS IN Cu(2+)(H2O)(SUB m) CLUSTERS
L. A. Curtiss and W. Rodriguez (Puerto Rico Univ., Bayamon.) Oct. 1992 10 p Presented at the 182nd Meeting of the Electrochemical Society, Toronto, Ontario, 11-16 Oct. 1992
(Contract W-31-109-eng-38)
(DE93-002988; ANL/CMT/CP-77775; CONF-921036-10) Avail: CASI HC A02/MF A01

The importance of many-body interactions is investigated for m = 4,6,8 in Cu(2+)(H2O)(m) clusters using ab initio molecular orbital theory. A slow convergence of the interaction terms to the full many-body result is found similar to what was found in a previous study of Fe(3+)(H2O)(m) clusters. Implications for molecular dynamics and Monte Carlo simulations are discussed. DOE

N93-21757# Argonne National Lab., IL.
MELT PROCESSING OF THE Bi2Sr2CaCu2O(y) SUPERCONDUCTOR IN OXYGEN AND ARGON ATMOSPHERES
T. G. Holesinger, D. J. Miller, and L. S. Chumbley (Ames Lab., IA.) Aug. 1992 5 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992
(Contracts W-31-109-eng-38; W-7405-eng-82)
(DE93-002999; ANL/CP-77532; CONF-920802-31) Avail: CASI HC A01/MF A01

Solidification and subsequent annealing of Bi2Sr2CaCu2O(y) (2212) in oxygen and argon atmospheres were investigated in order to identify alternative processing routes for controlling microstructures and superconducting properties. In addition to 2212, several other phases formed on cooling in O2 and did not disappear upon subsequent annealing. Crystallization in Ar resulted in a divorced eutectic structure of Bi2Sr(3-x)Ca(x)O(y) and Cu2O/CuO. The superconductor was formed on subsequent anneals. Samples melted in Ar and then annealed, generally possessed a more uniform microstructure compared with samples that were melted in oxygen and annealed. Compositional measurements of the 2212 phase suggest that CaO segregation in the melt may be minimized with an overall composition such as Bi(2.15)Sr2Ca(0.85)Cu2O(y). DOE

N93-21780# Los Alamos National Lab., NM.
GROWTH AND DEFECTS OF EXPLOSIVES CRYSTALS
H. H. Cady 1992 12 p Presented at the Material Research Society Fall Meeting, Boston, MA, 30 Nov. - 5 Dec. 1992
(Contract W-7405-eng-36)
(DE93-003866; LA-UR-92-3946; CONF-921101-9) Avail: CASI HC A03/MF A01

Large single crystals of PETN, RDX, and TNT can be grown easily from evaporating ethyl acetate solutions. The crystals all share a similar type of defect that may not be commonly recognized. The defect generates conical faces, ideally mosaic crystals, and may account for the 'polymorphs' of TNT and detonator grades of PETN. TATB crystals manufactured by the amination of trichlorotrinitrobenzene in dry toluene entrain two forms of ammonium chloride. One of these forms causes 'worm holes' in the TATB crystals that may be the reason for its unusually low failure diameters. Strained HMX crystals form mechanical twins that can spontaneously revert back to the untwinned form when the straining force is removed. Large strains or temperatures above 100 C lock in the mechanical twins. DOE

N93-21844# Oak Ridge National Lab., TN.
MAGNETIZATION AND FLUX PINNING IN HIGH-Tc CUPRATES: IRRADIATED AND OXYGEN DEFICIENT MATERIALS
J. R. Thompson, Yang Ren Sun (Tennessee Univ., Knoxville.), J. G. Ossandon (Tennessee Univ., Knoxville.), D. K. Christen, H. R. Kerchner, B. C. Sales, B. C. Chakoumakos, L. Civale (IBM Watson Research Center, Yorktown Heights, NY.), A. C. Marwick (IBM Watson Research Center, Yorktown Heights, NY.), and F. Holtzberg (IBM Watson Research Center, Yorktown Heights, NY.) Nov. 1992 6 p Presented at the 5th US/Japan Workshop on High Tc Superconductors, Tsukuka, Japan, 9-10 Nov. 1992
(Contract DE-AC05-84OR-21400)
(DE93-004169; CONF-9211144-2) Avail: CASI HC A02/MF A01

Recent studies of the intragrain current density J and vortex pinning in high Tc superconductors are surveyed. Materials include Y1Ba2Cu3O(7-delta) and Bi2Sr2Ca1Cu2O8 single crystals and aligned polycrystals. To probe the flux pinning, the strength, number, and morphology of defects were modified. Varying the oxygen content (7-delta) in YBa2Cu3O(7-delta) or irradiating the materials with ions, having either light or heavy masses, gives systematic changes in the character of the all-important defects. DOE

N93-21978# Argonne National Lab., IL.
DIFFRACTION STUDIES OF THE THERMAL PROPERTIES OF NANOCRYSTALLINE Pd AND Cr
J. A. Eastman, L. J. Thompson, M. R. Fitzsimmons (Los Alamos National Lab., NM.), A. C. Lawson (Los Alamos National Lab., NM.), and R. A. Robinson (Los Alamos National Lab., NM.) Sep. 1992 7 p Presented at the Conference on Nanostructured Materials, Cancun, Mexico, 21-25 Sep. 1992
(Contracts W-31-109-eng-38; W-7405-eng-36)
(DE93-002911; ANL/MSD/CP-77539; CONF-920947-2) Avail: CASI HC A02/MF A01

Quantitative X-ray and neutron diffraction measurements were made on nanocrystalline and coarse-grained samples of Pd and Cr. For both materials, Debye-Waller parameter comparisons over a temperature range of approximately 20-300 K indicate that the nanocrystalline materials have increased static displacements of atoms from their equilibrium sites compared to coarse-grained material. No grain-size-correlated differences in thermal vibrational amplitude, lattice parameter, or thermal expansion coefficients were observed in either material. In contrast to earlier results on nanocrystalline Pd, significantly more non-peak intensity is observed from a nanocrystalline Cr sample than from a coarse-grained Cr sample. Impurities may account for the increased background intensity from nanocrystalline Cr. These results indicate that there is no significant grain boundary excess volume in nanocrystalline Pd, and therefore the reduced density typically observed in nanocrystalline Pd samples must be due to porosity. DOE

N93-21981# Argonne National Lab., IL.
MICROSTRUCTURAL CHARACTERIZATION OF Ag-SHEATHED Tl-Ba-Ca-Cu-O AND Bi-Sr-Ca-Cu-O SUPERCONDUCTING TAPES BY ANALYTICAL ELECTRON MICROSCOPY
J. G. Hu, D. J. Miller, K. C. Goretta, and R. B. Poeppel Sep. 1992 5 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992
(Contract W-31-109-eng-38)
(DE93-002980; ANL/MSD/CP-77605; CONF-920802-29) Avail: CASI HC A01/MF A01

The microstructures of Tl(1223) and Pb-doped Bi(2223) silver tapes produced by the powder-in-tube (PM) method have been examined by scanning electron microscopy (SEM), transmission electron microscopy (TEM), and energy dispersive spectrometry (EDS). The Tl tapes annealed below the melting point exhibited fine grains and a high density of pores while tapes subjected to partial melting prior to solid state annealing were fully dense with large grains. However, these tapes also showed an increase in the size and density of impurity particles, particularly CaO and a Ba-Cu rich phase. Silver powders added to the precursors tended to promote the growth of Tl(1223) at lower temperatures but also interfered with the development of texture by providing nucleation sites of random orientations. In contrast, the Bi(2223) tape exhibited a high degree of texture and alignment. The incorporation of silver within the superconducting phase was found to be negligible for both the Tl(1223) and Bi(2223) tapes. DOE

N93-21983# Argonne National Lab., IL.
EFFECTIVE ACTIVATION ENERGY IN THE Bi-Sr-Ca-Cu-O SYSTEMS
S. Sengupta, D. Shi, Z. Wang, M. Smith, and P. J. McGinn (Notre Dame Univ., IN.) Aug. 1992 4 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992
(Contracts W-31-109-eng-38; DE-FG02-90ER-45427)
(DE93-002996; ANL/CP-77481; CONF-920802-36) Avail: CASI HC A01/MF A01

Magnetic relaxation in the Bi-Sr-Ca-Cu-O systems has been investigated in a wide temperature regime. Previously reported studies of the effective activation energy, U, have been controversial in terms of temperature and field dependence of the critical current density, j(sub c). We have considered the temperature dependence of j(sub c) and constructed the U-j (or M) curves for the Bi-Sr-Ca-Cu-O system. We found that at a constant driving force and temperature, U is considerably higher for 2245 samples than for 2223 samples. This enhancement can be attributed to the flux pinning from finely dispersed calcium- and copper-rich precipitates. DOE

N93-21984# Argonne National Lab., IL.
CRITICAL CURRENT DENSITY, IRREVERSIBILITY LINE, AND FLUX CREEP ACTIVATION ENERGY IN SILVER-SHEATHED Bi2Sr2Ca2Cu3O(SUB x) SUPERCONDUCTING TAPES
D. Shi, Z. Wang, S. Sengupta, M. Smith, L. F. Goodrich (National Inst. of Standards and Technology, Boulder, CO.), S. X. Dou (New South Wales Univ., Kensington, Australia.), H. K. Liu (New South Wales Univ., Kensington, Australia.), and Y. C. Guo (New South Wales Univ., Kensington, Australia.) Aug. 1992 4 p Presented at the Applied Superconductivity Conference, Chicago, IL, 23-28 Aug. 1992
(Contracts W-31-109-eng-38; DE-FG02-90ER-45427)
(DE93-002998; ANL/CP-77533; CONF-920802-30) Avail: CASI HC A01/MF A01

Transport data, magnetic hysteresis, and flux creep activation energy experimental results are presented for silver-sheathed high-(Tc) Bi2Sr2Ca2Cu3O(x) superconducting tapes. The 110 K superconducting phase was formed by lead doping in a Bi-Sr-Ca-Cu-0 system. The transport critical current density was measured at 4.0 K to be 0.7 x 10(exp 5) A/sq cm (the corresponding critical current is 74 A) at zero field and 1.6 x 10(exp 4) A/sq cm at 12 T for H(parallel)ab. Excellent grain alignment in the a-b plane was achieved by a short-melting method, which considerably improved the critical current density and irreversibility line. Flux creep activation energy as a function of current is obtained based on the magnetic relaxation measurements. DOE

N93-21996# Los Alamos National Lab., NM.
DOPING INDUCED INSULATOR-METAL TRANSITION IN THE PLATINUM BASED MX COMPLEXES
X. Z. Huang, A. Saxena, and A. R. Bishop 1992 6 p Presented at the 1992 International Conference on Science and Technology of Synthetic Metals, Goeteborg, Sweden, 12-18 Aug. 1992
(Contract W-7405-eng-36)
(DE93-003690; LA-UR-92-3238; CONF-9208132-4) Avail: CASI HC A02/MF A01

Platinum halide linear chain MX (X = Cl, Br, I) complexes exhibit various strengths of the charge-density-wave (CDW) ground state. One way of characterizing the strength is to study the response to charge doping. On a finite length chain, we found that PtCl preserves its CDW pattern while forming a polaron array when doped; PtI is rapidly unstable against charge doping and undergoes an insulator-metal transition easily; PtBr is in between PtCl and PtI. These trends are consistent with the CDW strength, which is strong for PtCl, medium for PtBr and very weak for PtI. DOE

N93-21997# Los Alamos National Lab., NM.
ESR SPECTRA OF PHOTOINDUCED DEFECTS IN MX CHAIN SOLIDS
A. Saxena, A. R. Bishop, I. Batistic, and M. Alouani 1992 7 p Presented at the 1992 International Conference on Science and Technology of Synthetic Metals, Goeteborg, Sweden, 12-18 Aug. 1992
(Contract W-7405-eng-36)
(DE93-003692; LA-UR-92-3236; CONF-9208132-6) Avail: CASI HC A02/MF A01

We calculate the electron spin resonance (ESR) spectra associated with the spin carrying nonlinear excitations such as neutral solitons, triplet excitons as well as electron and hole polarons for halogen-bridged mixed-valence transition metal (MX: M=Pt, X=Cl,Br,I) linear chain materials within a discrete, 3/4-filled, two-band, tight-binding extended Peierls-Hubbard model. The strongly distorted and localized CDW material, PtCl, is contrasted with the weak CDW, delocalized material, PtBr. The hyperfine structure in the ESR spectra arises from the spin density on the Pt atoms while the superhyperfine structure is attributed to a small spin density present on the halogen sublattice. These theoretical predictions are compared with the recent experimental ESR data on photoinduced defects in PtX materials. DOE

N93-21078# SED Systems, Inc., Saskatoon (Saskatchewan).
GEODE 2: MANUFACTURING LARGE AREA FORMAT CADMIUM-MERCURY-TELLURIDE CRYSTALS IN A MICROGRAVITY ENVIRONMENT. PRESSURE SENSOR PROOF OF CONCEPT
M. R. Gale and D. A. Beattie *In* Canadian Space Agency, Spacebound 1991 1991 p 36-41 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21079# Guelph Univ. (Ontario). Dept. of Chemistry and Biochemistry.
ELECTROCHEMICAL DEPOSITION OF THIN FILM SEMICONDUCTORS IN MICROGRAVITY: A FEASIBILITY STUDY
Jesko A. vonWindheim, Shixing Weng, Henry Wynand, and Michael Cocivera *In* Canadian Space Agency, Spacebound 1991 1991 p 42-47 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21080# Victoria Univ. (British Columbia). Dept. of Mechanical Engineering.
ON THE MODELLING OF THE DISSOLUTION AND LIQUID PHASE EPITAXIAL GROWTH PROCESSES IN A HORIZONTAL SANDWICH SYSTEM
S. Dost, S. Erbay, and H. A. Erbay *In* Canadian Space Agency, Spacebound 1991 1991 p 48-52 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21082# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
DEVELOPMENT OF A KNUDSEN CELL FOR MOLECULAR BEAM EPITAXIAL GROWTH OF GaAs FILMS IN THE MICROGRAVITY ENVIRONMENT Abstract Only
W. D. Morison *In* Canadian Space Agency, Spacebound 1991 1991

p 59 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21086# Saskatchewan Univ., Saskatoon.
CRYSTALLIZATION OF A PROTEIN ABOARD THE US SPACE SHUTTLE FLIGHT STS-31
Louis T. J. Delbaere, Margaret Vandonselaar, Lata Prasad, J. Wilson Quail, Lawrence J. DeLucas (Alabama Univ., Birmingham.), and Charles E. Bugg (Alabama Univ., Birmingham.) *In* Canadian Space Agency, Spacebound 1991 1991 p 74-75 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21107# Ceramics Kingston Ceramiques, Inc. (Ontario).
ELUCIDATION OF THE ROLE OF GRAVITY AND GRAVITY DRIVEN CONVECTION IN THE FORMATION OF SILICON CARBIDE/SILICON NITRIDE WHISKERS
S. N. Kumar, D. Mallette, A. Pant, and R. Sood *In* Canadian Space Agency, Spacebound 1991 1991 p 195-199 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

N93-21123# ThermaZone Engineering, Inc., Ottawa (Ontario).
CRYSTAL GROWTH THROUGH A COMPUTER CONTROLLED, EIGHT ZONE THERMAL GRADIENT FREEZE FURNACE
Michael R. Bishop *In* Canadian Space Agency, Spacebound 1991 1991 p 271-274 (For primary document see N93-21070 07-12)
Avail: Canadian Space Agency, P.O. Box 7275, Ottawa, ON, Canada K1L 8E3 HC

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N93-19977*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THERMODYNAMIC DATA FOR FIFTY REFERENCE ELEMENTS
Bonnie J. McBride, Sanford Gordon (Gordon, Sanford, Cleveland, OH.), and Martin A. Reno (Heidelberg Coll., Tiffin, OH.) Washington Jan. 1993 240 p
(RTOP 505-62-52)
(NASA-TP-3287; E-6874; NAS 1.60:3287) Avail: CASI HC A11/MF A03

This report is a compilation of thermodynamic functions of 50 elements in their standard reference state. The functions are C(sub p)(sup 0), (H(sup 0)(T) - H(sup 0)(0)), S(sup 0)(T), and -(G(sup 0)(T) - H(sup 0)(O)) for the elements Ag, Al, Ar, B, Ba, Be, Br2, C, Ca, Cd, Cl2, Co, Cr, Cs, Cu, F2, Fe, Ge, H2, He, Hg, I2, K, Kr, Li, Mg, Mn, Mo, N2, Na, Nb, Ne, Ni, O2, P, Pb, Rb, S, Si, Sn, Sr, Ta, Th, Ti, U, V, W, Xe, Zn, and Zr. Deuterium D2 and electron gas e(sup -) are also included. The data are tabulated as functions of temperature as well as given in the form of least-squares coefficients for two functional forms for C(sub p)(sup 0) with integration constants for enthalpy and entropy. One functional form for C(sub p)(sup 0) is a fourth-order polynomial and the other has two additional terms, one with T(exp -1) and the other with T(exp -2). The gases Ar, D2, e(sup -), H2, He, Kr, N2, Ne, O2, and Xe are tabulated for temperatures from 100 to 20,000 K. The remaining gases Cl2 and F2 are tabulated from 100 to 6000 K and 1000 to 6000 K. The second functional form for C(sub p)(sup 0) has an additional interval from 6000 to 20,000 K for the gases tabulated to 20,000 K. The fits are constrained so that the match at the common temperature endpoints. The temperature ranges for the condensed species vary with range of the data, phase changes, and shapes of the C(sub p)(sup 0) curves. Author (revised)

N93-20242# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
PROCEEDINGS OF THE INTERNATIONAL WORKSHOP ON QUANTUM EFFECT PHYSICS, ELECTRONICS, AND APPLICATIONS Final Report, 1 Jan. - 31 Dec. 1992
Henry Smith 15 Dec. 1992 270 p Workshop held in Luxor, Egypt, 6-10 Jan. 1992
(Contract N00014-92-J-1325)
(AD-A259457) Avail: CASI HC A12/MF A03

Quantum Effects Physics, Electronics, and Applications contains contributions presented at an international workshop held in Luxor, Egypt on 6-10 Jan. 1992. Topics covered include: (1) competing concepts and technologies with quantum effects; (2) theoretical calculations and models of bandstructures, transport, fluctuations, and noise in confined geometries; (3) nanofabrication; (4) transport experiments; (5) optical prpoerties and spectroscopy results in vertical superlattices, wires, dots, and arrays of dots and antidots; (6) resonant tunnelling and Coulomb blockade; and (7) applications based on quantum phenomena. Derived from text

N93-21067# Technische Hochschule, Darmstadt (Germany). Fachbereich Physik.
CALORIMETRIC EXAMINATION OF THE POLARIZATION CLUSTER OF THE BEGINNING FERROELECTRIC MATERIAL KTaO3 Ph.D. Thesis [KALORIMETRISCHE UNTERSUCHUNG DER POLARISATIONSCLUSTER DES BEGINNENDEN FERROELEKTRIKUMS KTAO3]
Stefan Riegel 1990 122 p In GERMAN
(ETN-93-93418) Avail: CASI HC A06/MF A02

The dynamics of KTaO3 is examined at low temperatures. By the analysis of the temporal behavior of the heat flow when the specimen is cooling, the total calorific capacity, the calorific capacities contained in the partial systems, and the relaxation times are determined in order to examine the beginning ferroelectric material KTaO3. The specific heat of this system was determined up to 140 mK. Experiments in electric field showed a thermal dissipation of the specimen. It was shown that dissipated heat does not originate from the quadrupole system, but is caused by dissipation effect, when spatial charges are moving in the specimen. ESA

N93-21737# Los Alamos National Lab., NM.
LECTURES ON 2D GRAVITY AND 2D STRING THEORY
P. Ginsparg and G. Moore (Yale Univ., New Haven, CT.) 17 Sep. 1992 86 p Presented at the TASI Summer School, Boulder, CO, 11-29 Jun. 1992
(Contracts W-7405-eng-36; DE-AC02-76ER-03075)
(DE93-003746; LA-UR-92-3479; CONF-9206314-1; YCTP-P-23-92) Avail: CASI HC A05/MF A01

This report discusses the following topics: loops and states in conformal field theory; brief review of the Liouville theory; 2D Euclidean quantum gravity 1 -- path integral approach; 2D Euclidean quantum gravity 2 -- canonical approach; states in 2D string theory; matrix model technology 1 -- method of orthogonal polynomials; matrix model technology 2 -- loops on the lattice; matrix model technology 3 -- free fermions from the lattice; loops and states in matrix model quantum gravity; loops and states in the C = 1 matrix model; 6V model fermi sea dynamics and collective field theory; and string scattering in two spacetime dimensions. DOE

N93-20729# Cornell Univ., Ithaca, NY.
PHYSICS-LIKE MATHEMATICAL MODEL FOR CHAOS AND ERGODIC CRITICALITY IN FOUR DIMENSIONS
M. S. ElNaschie *In* Manitoba Univ., Proceedings of the Thirteenth Canadian Congress of Applied Mechanics May 1991 p 756-757 (For primary document see N93-20616 07-39)
Copyright Avail: University of Manitoba, Winnipeg, MB R3T 2N2, Canada

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

N93-21797# National Academy of Sciences - National Research Council, Washington, DC. Office of Scientific and Engineering Personnel.
SCIENCE AND ENGINEERING PROGRAMS: ON TARGET FOR WOMEN Final Report, 1 Oct. 1991 - 12 Oct. 1992

Marsha Lakes Matyas, ed. and Linda Skidmore Dix, ed. 12 Oct. 1992 236 p
(PB93-116499; ISBN-0-309-04778-1; LC-92-61248) Avail: CASI HC A11/MF A03

The National Research Council's Committee on Women in Science and Engineering (CWSE) has several important roles related to the challenge of increasing women's participation in science and engineering including (1) to inform both the science and engineering community and the public of the need to increase economic competitiveness and educational and occupational equity and (2) to collect and disseminate information on programs designed to address that need. The committee's November 1991 conference on science and engineering programs examined a sample of interventions established in the private and public sectors to increase the participation of U.S. citizens, both men and women, in science and engineering careers; determined the characteristics shared by those programs; and discussed methods of implementing such programs more broadly. Initiators, administrators, and funders of interventions heightened awareness of what universities, corporations, foundations, and others are doing to encourage U.S. students to pursue careers in the sciences and engineering. The report summarizes presentations by experts and informal deliberations and presents information on specific strategies for increasing the participation of women in science and engineering--at the undergraduate and graduate levels of study and in all employment sectors. Those expected to benefit from its contents include the broad community of policy makers, educators, employers, researchers, women S&E undergraduate and graduate students, and scientists and engineers themselves. GRA

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N93-20329*# National Aeronautics and Space Administration, Washington, DC.
SSTAC/ARTS REVIEW OF THE DRAFT INTEGRATED TECHNOLOGY PLAN (ITP). VOLUME 1: PLENARY SESSION
28 Jun. 1991 306 p Conference held in McLean, VA, 24-28 Jun. 1991
(NASA-TM-108651; NAS 1.15:108651) Avail: CASI HC A14/MF A03

Briefings from the plenary session of the conference on SSTAC/ARTS Review of the Draft Integrated Technology Plan (ITP) held on 24-28 Jun. 1991 are included. Viewgraphs from the presentations are included. CASI

N93-20369# Army Research Inst. for the Behavioral and Social Sciences, Alexandria, VA.
CORRELATES OF CREATIVE PROBLEM SOLVING Final Report, Jun. 1988 - Jun. 1990
Steven R. Stewart and Donna C. Angle Oct. 1992 193 p
(AD-A258720; ARI-RN-93-01) Avail: CASI HC A09/MF A03

The purposes of this research were to identify individual differences related to unstructured problem-solving capability, and evaluate the effectiveness of a training course designed to enhance performance in solving unstructured problems. One group underwent training designed to teach thinking process skills. The second group underwent instruction about thinking and problem solving that was content (not process) oriented. Four predictors accounted for 60 percent of the criterion's variance. They were, in order of importance, mental rotations, use of intuition, use of introversion (both as assessed with the Myers-Briggs Type Indicator), and risk-taking propensity. Students taking the thinking process training significantly outscored those taught only about problems and errors in human judgment and decision making. GRA

N93-20394# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
DEFINING CONTRACT TERMS M.S. Thesis
Michael J. Cushing Sep. 1992 238 p
(AD-A259088; AFIT/GCM/LSP/92S-3) Avail: CASI HC A11/MF A03

Consensus definitions for fifty-one (51) contracting-terms was developed. This was accomplished by developing a synthesized definition for each term based on a review of the available published literature, subjecting the synthesized definitions to expert scrutiny via a survey distributed to recognized contracting professionals, and amending the literature-based definitions as indicated by the survey responses. Using this approach, consensus was achieved on all but one term. The consensus definitions developed in this way are recommended for inclusion in a comprehensive dictionary of contracting terminology, to be comprised of the results of this and other related theses. In addition, as indicated by the survey results, three terms are recommended for further study in a later thesis effort. GRA

N93-20403# Wright Lab., Wright-Patterson AFB, OH.
WRIGHT LABORATORY RESEARCH AND DEVELOPMENT FACILITIES HANDBOOK
Margaret B. Skujins Aug. 1992 411 p Supersedes WRDC-TR-90-0001
(AD-A258746; WL-TR-92-0004; WRDC-TR-90-0001) Avail: CASI HC A18/MF A04

This handbook contains a listing of Wright Laboratory research and development facilities located at Wright Patterson AFB, OH and Eglin AFB, FL. Facilities included are those of the Aero Propulsion and Power, Armament, Avionics, Flight Dynamics, Materials, Plans and Programs, and Solid State Electronic Directorates. Documented listings include information on facility type, capabilities, instrumentation, availability, and point of contact. GRA

N93-20774*# National Aeronautics and Space Administration, Washington, DC.
SSTAC/ARTS REVIEW OF THE DRAFT INTEGRATED TECHNOLOGY PLAN (ITP). VOLUME 6: CONTROLS AND GUIDANCE
28 Jun. 1991 215 p Conference held in McLean, VA, 24-28 Jun. 1991
(NASA-TM-108654; NAS 1.15:108654) Avail: CASI HC A10/MF A03

Viewgraphs of briefings from the Space Systems and Technology Advisory Committee (SSTAC)/ARTS review of the draft Integrated Technology Plan (ITP) on controls and guidance are included. Topics covered include: strategic avionics technology planning and bridging programs; avionics technology plan; vehicle health management; spacecraft guidance research; autonomous rendezvous and docking; autonomous landing; computational control; fiberoptic rotation sensors; precision instrument and telescope pointing; microsensors and microinstruments; micro guidance and control initiative; and earth-orbiting platforms controls-structures interaction. CASI

N93-20775*# National Aeronautics and Space Administration, Washington, DC.
SSTAC/ARTS REVIEW OF THE DRAFT INTEGRATED TECHNOLOGY PLAN (ITP). VOLUME 8: AEROTHERMODYNAMICS AUTOMATION AND ROBOTICS (A/R) SYSTEMS SENSORS, HIGH-TEMPERATURE SUPERCONDUCTIVITY
28 Jun. 1991 318 p Meeting held in McLean, VA, 24-28 Jun. 1991
(NASA-TM-108655; NAS 1.15:108655) Avail: CASI HC A14/MF A03

Viewgraphs of briefings presented at the SSTAC/ARTS review of the draft Integrated Technology Plan (ITP) on aerothermodynamics, automation and robotics systems, sensors, and high-temperature superconductivity are included. Topics covered include: aerothermodynamics; aerobraking; aeroassist flight experiment; entry technology for probes and penetrators; automation and robotics; artificial intelligence; NASA telerobotics program; planetary rover program; science sensor technology; direct detector; submillimeter sensors; laser sensors; passive microwave sensing; active microwave sensing; sensor electronics; sensor optics; coolers and cryogenics; and high temperature superconductivity. CASI

N93-20904# General Accounting Office, Washington, DC.
NASA ISSUES
Dec. 1992 26 p
(GAO/OCG-93-27TR) Avail: CASI HC A03/MF A01; GAO, PO Box 6015, Gaithersburg, MD 20877 HC

In response to a request, this transition series report discusses major policy, management, and program issues facing the Congress and the new administration at the National Aeronautics and Space Administration (NASA). This report recognizes the changes that have occurred since our first NASA transition report 4 years ago and summarizes the current challenges facing the agency: (1) bringing plans in line with likely budgets; (2) managing systems development more efficiently; (3) improving operations and oversight; and (4) preserving U.S. aeronautics leadership. Author

N93-21128*# National Aeronautics and Space Administration, Washington, DC.

THE NASA PLAN: TO AWARD EIGHT PERCENT OF PRIME AND SUBCONTRACTS TO SOCIALLY AND ECONOMICALLY DISADVANTAGED BUSINESSES

1990 13 p

(NASA-NP-136; NAS 1.83:136) Avail: CASI HC A03/MF A01

It is NASA's intent to provide small disadvantaged businesses, including women-owned, historically black colleges and universities and minority education institutions the maximum practicable opportunity to receive a fair proportion of NASA prime and subcontracted awards. Annually, NASA will establish socioeconomic procurement goals including small disadvantaged business goals, with a target of reaching the eight percent level by the end of FY 1994. The NASA Associate Administrators, who are responsible for the programs at the various NASA Centers, will be held accountable for full implementation of the socioeconomic procurement plans. Various aspects of this plan, including its history, are discussed. CASI

N93-21188*# National Aeronautics and Space Administration, Washington, DC.

NASA SYSTEMS ENGINEERING HANDBOOK. DRAFT

Robert Shishko (Jet Propulsion Lab., California Inst. of Tech., Pasadena.), Robert G. Chamberlain (Jet Propulsion Lab., California Inst. of Tech., Pasadena.), Robert Aster (Jet Propulsion Lab., California Inst. of Tech., Pasadena.), Vincent Bilardo (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.), Kevin Forsberg (Center for Systems Management, Santa Clara, CA.), Walter E. Hammond (Sverdrup Technology, Inc., Huntsville, AL.), Harold Mooz (Center for Systems Management, Santa Clara, CA.), Lou Polaski (Center for Systems Management, Santa Clara, CA.), Ron Wade (Center for Systems Management, Santa Clara, CA.), and Randy Cassingham, ed. (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) Sep. 1992 129 p

(NASA-TM-108702; NAS 1.15:108702) Avail: CASI HC A07/MF A02

This handbook is intended to provide information on systems engineering that will be useful to NASA system engineers, especially new ones. Its primary objective is to provide a generic description of systems engineering as it should be applied throughout NASA. Field Center Handbooks are encouraged to provide center-specific details of implementation. For NASA system engineers to choose to keep a copy of this handbook at their elbows, it must provide answers that cannot be easily found elsewhere. Consequently, it provides NASA-relevant perspectives and NASA-particular data. NASA management instructions (NMI's) are referenced when applicable. This handbook's secondary objective is to serve as a useful companion to all of the various courses in systems engineering that are being offered under NASA's auspices. The coverage of systems engineering is general to techniques, concepts, and generic descriptions of processes, tools, and techniques. It provides good systems engineering practices, and pitfalls to avoid. This handbook describes systems engineering as it should be applied to the development of major NASA product and producing systems. Derived from text

N93-21231# Federal Coordinating Council for Science, Engineering and Technology, Washington, DC.

BY THE YEAR 2000: FIRST IN THE WORLD. FY 1993 BUDGET SUMMARY

Jan. 1992 67 p

(PB93-108512) Avail: CASI HC A04/MF A01

In April 1991, President Bush announced a comprehensive national strategy for achieving the six National Education Goals, including the improvement of mathematics, science and technology education. Entitled 'AMERICA 2000', the strategy identifies four tracks for accomplishing national education reform: making better and more accountable schools for today's students; creating a new generation of American schools for tomorrow's students; becoming a 'nation of students'; and making communities places where learning can happen. Because the focal point of AMERICA 2000 is the National Education Goals, and because CEHR priorities are based on those goals as they relate to mathematics, science, and technology, the committee has a well-established programmatic and budgetary framework to help further the goals and objectives of AMERICA 2000. The report summarizes the President's FY 1993 budget request for mathematics, science, and technology education in support of AMERICA 2000; provides budget highlights by agency; provides background on the committee and its role in implementing the AMERICA 2000 education strategy; and outlines the committee's future course of work. GRA

N93-21304# Pacific Northwest Lab., Richland, WA.

CONTINUOUS IMPROVEMENT ON A RESEARCH AND DEVELOPMENT ENVIRONMENT

F. C. Hood Sep. 1992 9 p Presented at the 19th Annual American Society for Quality Control (ASQC) National Energy Division Conference, Orlando, FL, 20-23 Sep. 1992

(Contract DE-AC06-76RL-01830)

(DE93-001561; PNL-SA-21253; CONF-9209141-4) Avail: CASI HC A02/MF A01

At Pacific Northwest Laboratory (PNL), continuous improvement (CI) concepts are integrated into research and development (R&D) program and project management. Major management initiatives have been established to promote cultural acceptance of CI and foster a working environment for excellence. Laboratory management are committed to CI tailored to specific R&D, functional, and staff needs to ensure PNL's integrated management system provides the means to quality in performance and customer satisfaction. Continuous improvement philosophy applies to R&D as well as more conventional engineering and administrative activities. It is a value-added process for excellence and success. DOE

N93-21357# General Accounting Office, Washington, DC. National Security and Internal Affairs Div.

GODDARD SPACE FLIGHT CENTER: DECISION TO CONTRACT FOR PLANT OPERATIONS AND MAINTENANCE. REPORT TO THE CHAIR, SUBCOMMITTEE ON VA, HUD, AND INDEPENDENT AGENCIES, COMMITTEE ON APPROPRIATIONS, US SENATE

Jan. 1993 10 p

(GAO/NSIAD-93-92; B-251323) Avail: CASI HC A02/MF A01; GAO, PO Box 6015, Gaithersburg, MD 20877 HC

We reviewed certain impacts of Goddard Space Flight Center's decision to contract out the operations and maintenance of its plant facilities. Specifically, we compared the cost of the current mixed work force of civil service and contractor employees who perform these functions with the cost of (1) an all civil service work force and (2) an all contractor work force. We also reviewed the benefits realized, and the problems encountered, by Goddard as a result of the contracting decision and the transitioning of some of the functions from a civil service staff to a contractor staff. In addition, we obtained information from Langley Research Center, which has a similar mix of contractor and civil service staff performing operations and maintenance functions, to see if any lessons could be learned that might apply to Goddard. Performing plant operations and maintenance functions with an all contractor work force would be the least costly of the three staffing patterns we examined. Continuing the current mixed work force would be the most expensive. Although completing the transition to an all contractor work force would be the least costly, Goddard officials told us that this option would not result in immediate savings because of the center's commitment not to involuntarily separate any of the current civil service employees. Derived from text

N93-21548# Small Business Administration, Washington, DC. Office of Advocacy.

SMALL BUSINESS PROFILES, 1992

Nov. 1992 656 p

(PB93-110914) Avail: CASI HC A99/MF A06

The profile provides an excellent overview of the important role of small business by state. Included are data on the composition of the state's small business sector, job creation, business formation and dissolution, and small business income. In addition, it includes information recently available on the growth of minority- and women-owned businesses in each state. GRA

N93-21743# Ernst and Young, Washington, DC.

MANUFACTURING INNOVATIONS AND SMALL BUSINESS: HOW FLEXIBLE MANUFACTURING SYSTEMS AFFECT TOOLING AND MACHINING ENTERPRISES Final Report

Albert N. Link Aug. 1992 85 p

(Contract SBA-4122-OA-89)

(PB92-216258) Avail: CASI HC A05/MF A01

Research was conducted to gain a fuller understanding of the extent to which small enterprises adopt elements of flexible manufacturing. The reasons for adopting these elements; difficulties small businesses encounter when they do so; decision-making about adopting these elements; and the ensuing effects on flexibility, product value, efficient use of fewer inputs, sales, and profits are discussed. Author (GRA)

N93-21794*# National Aeronautics and Space Administration, Washington, DC.
NASA SBIR ABSTRACTS OF 1990 PHASE 1 PROJECTS
F. C. Schwenk (Futron Corp., Bethesda, MD.), J. A. Gilman (Futron Corp., Bethesda, MD.), and J. B. Paige (Futron Corp., Bethesda, MD.) Aug. 1991 112 p
(NASA-TM-108145; NASA-SBIR-PC-90; NAS 1.15:108145) Avail: CASI HC A06/MF A02

The research objectives of the 280 projects placed under contract in the National Aeronautics and Space Administration (NASA) 1990 Small Business Innovation Research (SBIR) Phase 1 program are described. The basic document consists of edited, non-proprietary abstracts of the winning proposals submitted by small businesses in response to NASA's 1990 SBIR Phase 1 Program Solicitation. The abstracts are presented under the 15 technical topics within which Phase 1 proposals were solicited. Each project was assigned a sequential identifying number from 001 to 280, in order of its appearance in the body of the report. The document also includes Appendixes to provide additional information about the SBIR program and permit cross-reference in the 1990 Phase 1 projects by company name, location by state, principal investigator, NASA field center responsible for management of each project, and NASA contract number. Author (revised)

N93-21949# Carnegie Commission on Science, Technology, and Goverment, New York, NY.
INTERNATIONAL ENVIRONMENTAL RESEARCH AND ASSESSMENT: PROPOSALS FOR BETTER ORGANIZATION AND DECISION MAKING
Jesse H. Ausubel, Thomas F. Malone, John F. Ahearne, Harvey Brooks, Philip W. Hemily, Rodney W. Nichols, Walter A. Rosenblith, Eugene B. Skolnikoff, H. Guyford Stever, and David G. Victor et al Jul. 1992 83 p
(ISBN-1-881054-01-2) Avail: CASI HC A05/MF A01

Many countries have developed sophisticated mechanisms to advise and assist governmental decision making as it is affected by and affects science and technology at the national level. In the United States such mechanisms include the White House Office of Science and Technology Policy (OSTP)--which is directed by the President's Science Advisor, the Congressional Office of Technology Assessment (OTA), and the National Research Council (NRC). In this age of interdependence it is natural that the question of science advising at the international level also arises. This report focuses on international needs for science advice in the field of the Environment. Environment and health are among the fields in which the need for information and advice, developed and provided in a multilateral way, are most obvious and pressing. One need only mention such problems as stratospheric ozone depletion, climate change, loss of biological diversity, AIDS, and tuberculosis, to see the large number of opportunities for international cooperation. Derived from text

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software*.

N93-19970*# San Jose State Univ., CA.
ON THE TYPOGRAPHY OF FLIGHT-DECK DOCUMENTATION
Asaf Degani Dec. 1992 40 p
(Contract NCC2-327)
(NASA-CR-177605; A-93049; NAS 1.26:177605) Avail: CASI HC A03/MF A01

Many types of paper documentation are employed on the flight-deck. They range from a simple checklist card to a bulky Aircraft Flight Manual (AFM). Some of these documentations have typographical and graphical deficiencies; yet, many cockpit tasks such as conducting checklists, way-point entry, limitations and performance calculations, and many more, require the use of these documents. Moreover, during emergency and abnormal situations, the flight crews' effectiveness in combating the situation is highly dependent on such documentation; accessing and reading procedures has a significant impact on flight safety. Although flight-deck documentation are an important (and sometimes critical) form of display in the modern cockpit, there is a dearth of information on how to effectively design these displays. The object of this report is to provide a summary of the available literature regarding the design and typographical aspects of printed matter. The report attempts 'to bridge' the gap between basic research about typography, and the kind of information needed by designers of flight-deck documentation. The report focuses on typographical factors such as type-faces, character height, use of lower- and upper-case characters, line length, and spacing. Some graphical aspects such as layout, color coding, fonts, and character contrast are also discussed. In addition, several aspects of cockpit reading conditions such as glare, angular alignment, and paper quality are addressed. Finally, a list of recommendations for the graphical design of flight-deck documentation is provided. Author (revised)

N93-20002# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
Ada IMPLEMENTATION OF AN OBJECT DATA REPOSITORY M.S. Thesis
Stephen P. Perucca Dec. 1992 196 p
(AD-A259144; AFIT/GCS/ENG/92D-11) Avail: CASI HC A09/MF A03

The many benefits of object-oriented software development such as encapsulation and extendibility have inspired numerous models of the object-oriented paradigm. Rumbaugh's Object Modeling Technique (OMT) is an object-oriented model that uses three submodels. The object, dynamic, and functional submodels of the OMT describe the data, behavioral, and processing aspects of a system by using entity-relationship, state-transition, and data flow models. Cross-links relate how the three submodels tie together. Two metamodels (models of models) of the OMT are developed using the OMT methodology and notation. The essential data elements of the OMT are abstracted into a data metamodel, and the graphical elements are abstracted into a drawing metamodel. Visual programming concepts and examples are briefly discussed. The OMT model is analyzed and designed using OMT object models. The data and drawing elements are modeled and implemented in standard Ada as object classes, associations, and aggregations. An object manager is developed to provide a generic core class, to maintain an object data repository, and to assert unique object identities. Instantiated examples (instance diagrams) verify the correctness of the metamodel designs. Problems encountered during development are discussed and recommendations are made to improve the OMT. Possible future research areas are presented. GRA

N93-20010# SRI International Corp., Menlo Park, CA.
RESEARCH IN TEXT PROCESSING Final Report
Jerry R. Hobbs 21 Dec. 1992 26 p
(Contract N00014-90-C-0220; APRA Order 7331)
(AD-A259434; SRI-ECU-1592) Avail: CASI HC A03/MF A01

SRI's DARPA-sponsored project on text processing has consisted of a broad range of efforts, from near-term practical system implementation to advanced theoretical research. The research was carried out between Sep. 1990 - Nov. 1992. Two distinct text processing tasks were perforemd: information extraction and text understanding. In information extraction, only a fraction of the text is relevant; in the case of the MUC-4 terrorist reports, probably only about 10 percent of the text is relevant. Information is mapped into a predefined, relatively simple, rigid target representation; this condition holds whenever entry of information into a database is the task. The subtle nuances of meaning and the writer's goals in writing the text are of no interest. In text understanding, the aim is to make sense of the entire text; the target representation must accommodate the full complexities of langauge. The nuances of meaning and the writer's goals are to be recognized. GRA

N93-20011# SRI International Corp., Menlo Park, CA.
FASTUS: A SYSTEM FOR EXTRACTING INFORMATION FROM NATURAL-LANGUAGE TEXT
Jerry R. Hobbs, Douglas Appelt, Sr., John S. Bear, David Israel, Sr., and

W. M. Tyson 19 Nov. 1992 36 p
(Contract N00014-90-C-0220)
(AD-A259435; SRI-TN-519) Avail: CASI HC A03/MF A01

FASTUS is a system for extracting information from free text in English, and potentially other languages as well, for entry into a database, and potentially for other applications. It works essentially as a cascaded, nondeterministic finite state automaton. There are four steps in the operation of FASTUS. In step 1 sentences are scanned for certain trigger words to determine whether further processing should be done. In step 2 noun groups, verb groups, and prepositions and some other particles are recognized. The input to step 3 is the sequence of phrases recognized in step 2; patterns of interest are identified in step 3 and corresponding incident structures are built up. In step 4 incident structures that derive from the same incident are identified and merged, and these are used in generating database entries. FASTUS is an order of magnitude faster than any comparable system; it can process a news report in an average of less than eleven seconds. This translates directly into fast development time. In the three and a half weeks between its first use and the MUC-4 evaluation in May 1992, we were able to build up its domain knowledge to a point where it was among the leaders in the evaluation. GRA

N93-20048# Florida Univ., Gainesville.
MANAGEMENT OF AUTOMATIC DATA PROCESSING (ADP) SYSTEM DOCUMENTATION IN THE DEPARTMENT OF DEFENSE
Tammy P. Campbell 1992 17 p
(Contract N00123-89-G-0549)
(AD-A258507) Avail: CASI HC A03/MF A01

One aspect of management of ADP (Automated Data Processing) in the Federal Government is system documentation. Good system documentation is the backbone to the success of any automated system, for only through complete and thorough documentation can the user fully understand and utilize a system's capability. The system reviewed is the Naval Air Logistics Command Management Information System (NALCOMIS). The review is approached from the user's aspect. The review of this system involves the level of ability required for the user to understand and properly use the functionality provided by the system, the documentation requirements, and the problems associated with the user's interface to the system. Many problems exist with computer manuals that contained an inappropriate level of technical detail, style, format, and content. The positive and negative aspects of the user documentation and recommendations or suggestions to improve the documentation for the user's benefit are demonstrated. GRA

N93-20110*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
NASA/DOD AEROSPACE KNOWLEDGE DIFFUSION RESEARCH PROJECT. PAPER 27: KNOWLEDGE DIFFUSION AND US GOVERNMENT TECHNOLOGY POLICY: ISSUES AND OPPORTUNITIES FOR SCI/TECH LIBRARIANS
Thomas E. Pinelli, Rebecca O. Barclay (Rensselaer Polytechnic Inst., Troy, NY.), Stan Hannah (Kentucky Univ., Lexington.), Barbara Lawrence (American Inst. of Aeronautics and Astronautics, Washington, DC.), and John M. Kennedy (Indiana Univ., Bloomington.) 1992 24 p Repr. from Science and Technology Libraries, v. 13, no. 1, 1992 p 33-55
(Grant NAGw-1682)
(NASA-TM-108680; NAS 1.15:108680) Copyright Avail: CASI HC A03/MF A01

Federal involvement in simulating economic growth through the development and application of technology policy is currently the subject of serious debate. A recession and the recognition that an internationally competitive economy is a prerequisite for the attainment of national goals have fostered a number of technology policy initiatives aimed at improving the economic competitiveness of American industry. This paper suggests that the successful implementation of U.S. technology policy will require the adoption of a knowledge diffusion model, the development of user oriented information products and services, and a more 'activist' approach on the part of sci/tech librarians in the provision of scientific and technical information (STI). These changes will have a dramatic impact on the sci/tech library of the future and the preparation of sci/tech librarians. Author

N93-20111*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
NASA/DOD AEROSPACE KNOWLEDGE DIFFUSION RESEARCH PROJECT. PAPER 26: THE RELATIONSHIP BETWEEN TECHNOLOGY POLICY AND SCIENTIFIC AND TECHNICAL INFORMATION WITHIN THE US AND JAPANESE AEROSPACE INDUSTRIES
Thomas E. Pinelli, Rebecca O. Barclay (Rensselaer Polytechnic Inst., Troy, NY.), and John M. Kennedy (Indiana Univ., Bloomington.) 1993 29 p Presented at the Third Annual JICST/NTIS Conference on How to Locate and Acquire Japanese Scientific and Technical Information, San Francisco, CA, 18 Mar. 1993
(NASA-TM-108679; NAS 1.15:108679) Avail: CASI HC A03/MF A01

Government technology policy has nurtured the growth of the aerospace industry which is vital to both the U.S. and Japanese economies. Japanese technology policy differs significantly from U.S. technology policy, however, particularly with respect to the production, transfer, and use of scientific and technical information (STI). In this paper, we discuss the unique position of the aerospace industry in the U.S. and Japan, U.S. and Japanese aerospace policy, and the role of STI in the process of aerospace innovation. The information-seeking behaviors of U.S. and Japanese aerospace engineers and scientists are compared. The authors advocate the development of innovation-adoption technology and STI policy goals for U.S. aerospace and the inclusion of an aerospace knowledge diffusion transfer system with an 'active' component for scanning and acquiring foreign aerospace technology and STI. Author

N93-20161*# Catholic Univ. of America, Washington, DC. Dept. of Electrical Engineering.
PERFORMANCE EVALUATION OF PLATFORM DATA MANAGEMENTSYSTEM UNDER VARIOUS DEGREES OF PROTOCOL IMPLEMENTATION Final Report, 1 Oct. 1989 - 30 Nov. 1990
Mohammed Arozullah 8 Feb. 1991 78 p
(Grant NAG5-1285)
(NASA-CR-192408; NAS 1.26:192408) Avail: CASI HC A05/MF A01

The Platform Data Management System (DMS) collects Housekeeping (H/K), Payload (P/L) Engineering, and Payload Science data from various subsystems and payloads on the platform for transmission to the ground through the downlink via TDRSS. The DMS also distributes command data received from the ground to various subsystems and payloads. In addition, DMS distributes timing and safemode data. The function of collection and distribution of various types of data is performed by the Command and Data Handling (C&DH) subsystem of DMS. The C&DH subsystem uses for this purpose a number of data buses namely, Housekeeping, Payload Engineering, Payload Science, and Time and Safemode buses. Out of these buses, the H/K, P/L Engineering, and P/L Science buses are planned to be implemented by using MIL-STD 1553 bus. Most of the period covered was spent in developing a queue theoretic model of the 1553 Bus as used in the DMS. The aim is to use this model to test the performance and suitability of the 1553 Bus to the DMS under a number of alternative design scenarios. Derived from text

N93-20165 Maryland Univ. Baltimore County, Catonsville.
CASE/SIMULATION SYSTEMS Ph.D. Thesis
James Roy Warren 1992 325 p
Avail: Univ. Microfilms Order No. DA9302744

To aid information systems (IS) developers in the design of systems meeting the dynamic aspects of system requirements, a prototype simulation environment for IS design performance modeling has been implemented. The prototype uses data flow diagrams (DFDs) augmented with the performance rates of system components to specify the structure of IS designs. The DEF-based representation is automatically mapped to a queuing network simulation. Knowledge-based help supports formulation of simulation run parameters and interpretation of output. A within-subjects experimental design tests the prototype's impact on accuracy of IS design dynamics assessment. IS professionals answer eight questions on each of four cases; simulation capability is available for two of the cases. Half of the questions involve throughput, service and operating times, and utilization, and can be answered via relatively simple analytic reasoning. The other half, emergent questions, involve waiting times, system times, and queue lengths of jobs or customers. Emergent questions require simulation results or complex analytic analysis to formulate responses. Accuracy of responses is scored objectively in terms of the factor of error from pre-determined values. The

prototype's simulation capability has an effect on accuracy scores of emergent questions significant at the 0.04 percent level, and insensitive over a variety of possible accuracy-scoring methods. The observed positive effect is equivalent to correcting one factor-of-two error and one factor-of-1.27 error on the four emergent questions of each case. Subjects conducting more simulation runs score significantly higher. The best-scoring group of subjects can be distinguished by the larger total number of weeks simulated. Simulation capability as delivered by the prototype leads to more accurate assessments of IS design dynamics. This finding provides a basis for claiming that embedding the prototype's capabilities in a computer-aided software engineering (CASE) workbench would result in better-designed systems. The finding that more extensive use of simulation is strongly correlated with accuracy of decisions is suggestive for all applications of computer simulation to decision support. Further experiments are needed to determine the interaction of simulation capability with the IS design process, the invariance of results for larger problems, and which aspects of simulation use affect the accuracy of decisions. Dissert. Abstr.

N93-20315*# Research Inst. for Computing and Information Systems, Houston, TX.

FORMALIZING STRUCTURED FILE SERVICES FOR THE DATA STORAGE AND RETRIEVAL SUBSYSTEM OF THE DATA MANAGEMENT SYSTEM FOR SPACESTATION FREEDOM Final Report

Damir A. Jamsek (Odyssey Research Associates, Inc., Ithaca, NY.) 8 Feb. 1993 23 p

(Contract NCC9-16; RICIS Proj. IR-04)

(NASA-CR-192293; NAS 1.26:192293) Avail: CASI HC A03/MF A01

A brief example of the use of formal methods techniques in the specification of a software system is presented. The report is part of a larger effort targeted at defining a formal methods pilot project for NASA. One possible application domain that may be used to demonstrate the effective use of formal methods techniques within the NASA environment is presented. It is not intended to provide a tutorial on either formal methods techniques or the application being addressed. It should, however, provide an indication that the application being considered is suitable for a formal methods by showing how such a task may be started. The particular system being addressed is the Structured File Services (SFS), which is a part of the Data Storage and Retrieval Subsystem (DSAR), which in turn is part of the Data Management System (DMS) onboard Spacestation Freedom. This is a software system that is currently under development for NASA. An informal mathematical development is presented. Section 3 contains the same development using Penelope (23), an Ada specification and verification system. The complete text of the English version Software Requirements Specification (SRS) is reproduced in Appendix A.

Derived from text

N93-20366# Air Force Satellite Control Facility, Sunnyvale, CA.

SURVEY OF SPACE ENVIRONMENT SERVICES CENTER USERS AND SERVICES

Larry Combs, Thomas Niichel, and Norman Cohen May 1992 10 p

(AD-A258672; AFSFC/CP-92/001) Avail: CASI HC A02/MF A01

The Space Environment Services Center (SESC) provides various products and services in support of users of solar-terrestrial information. In the past, representation by users of solar-terrestrial and predictions services has been regrettably low at the Solar Terrestrial Predictions (STP) Workshops. For users of solar-terrestrial information, and especially those who would be unable to attend the workshop, a survey was designed to help present their views. The survey presents a statistical study of the types of users surveyed, the SESC products and services used, how SESC is meeting user needs, and how SESC can improve products and services to the user. Results of this survey will enable SESC to provide more useful and effective products and services to the user. GRA

N93-20370# Army Construction Engineering Research Lab., Champaign, IL.

BUILDING A KNOWLEDGE BASE FOR THE KNOWLEDGE WORKER SYSTEM Interim Report

Beverly E. Thomas and Wayne J. Schmidt Aug. 1992 24 p

(DA Proj. 4A1-62784-AT-41)

(AD-A258544; CERL-IR-FF-92/102) Avail: CASI HC A03/MF A01

Every daily activity of the U.S. Army depends in part on the work of knowledge workers--action officers who gather, process, and pass on information essential for mission accomplishment. The effectiveness of knowledge workers is often impaired by constantly shifting schedules, information overload, lack of standard automated tools, and the requirements of accomplishing necessary-but-mundane tasks such as scheduling, coordinating with others, and reporting. USACERL is developing a computer-based performance support environment called the Knowledge Worker System (KWS), which is intended to substantially reduce the problems and inefficiencies inherent in knowledge work. The objective of this phase of the research was to identify the information needed to establish the rich database required to support KWS applications. It has been found that any knowledge work task may be characterized by one (or more) of 13 attributes. Similarly, the work of any functional knowledge work group may be characterized by some or all of these 13 task attributes. The information to be collected depends on the objectives of the specific application--not all applications will require data pertaining to all 13 task attributes. GRA

N93-20374# Wisconsin Univ., Madison. Dept. of Medical Physics.

ARMY MEDICAL IMAGING SYSTEM - ARMIS Final Report

Melvin P. Siedband, James R. Gray, Frank C. Grenzow, Huilian Zhang, and Craig A. Heilman 8 Aug. 1992 76 p

(Contract DAMD17-89-C-8058; DA Proj. 3M4-63807-D-836)

(AD-A258685) Avail: CASI HC A05/MF A01

The Army Medical Imaging System (ARMIS) would use optical data cards, discs and small computers to perform the required functions of image acquisition, archiving, duplicating, reporting and scheduling. A study done under a previous contract, DAMD17-86-C-6039, determined the optimal configuration of a filmless medical imaging system based on stimulable x-ray phosphors and optical data cards. Advantages of the system would be elimination of film, development chemicals, and the need for water; reduction of power requirements, bulk media, archive volume and cost per image. Items to be delivered are demonstration models of a stimulable phosphor screen laser scanner, an image acquisition workstation, and an optical digital data card based independent viewer. Subcontractor bids for the stimulable phosphor scanner were far higher than original estimates solicited from potential bidders prior to the award of this contract. As a result, the scope of this contract was limited to the development of an imaging workstation-based on the Apple Macintosh, an independent viewer to display the contents of optical data cards and software techniques for image data compression and transmission. GRA

N93-20388# Army Aviation Center, Fort Rucker, AL. Aviation Technical Library.

USA AVIATION DIGEST INDEX, 1989, VOLUME 11 Final Report, Jan. - Dec. 1989

Beverly M. Hall, Deirdre D. Kennedy, and Gwendolyn McGuire Nov. 1992 47 p

(AD-A258673) Avail: CASI HC A03/MF A01

This is an author and subject index of articles published in the United States Army Aviation Digest. Articles by and about an individual will appear under his/her name. GRA

N93-20389# Army Aviation Center, Fort Rucker, AL. Aviation Technical Library.

INDEX TO USA AVIATION DIGEST, 1990 Final Report, Jan. - Dec. 1990

Beverly M. Hall, Deirdre D. Kennedy, and Gwendolyn McGuire Nov. 1992 38 p

(AD-A258678) Avail: CASI HC A03/MF A01

This is an author and subject index of articles published in the United States Army Aviation Digest. Articles by and about an individual will appear under his/her name. GRA

N93-20390# Army Aviation Center, Fort Rucker, AL. Aviation Technical Library.

INDEX TO USA AVIATION DIGEST, 1991 Final Report, Jan. - Dec. 1991

Beverly M. Hall, Deirdre D. Kennedy, and Gwendolyn McGuire Nov. 1992 34 p

(AD-A258679) Avail: CASI HC A03/MF A01

This is an author and subject index of articles published in the United

States Army Aviation Digest. Articles by and about an individual will appear under his/her name. GRA

N93-20393# Naval Aerospace Medical Research Lab., Pensacola, FL.
BIBLIOGRAPHY OF SCIENTIFIC PUBLICATIONS 1977-1991
Bibliography Report, 1977 - 1991
K. S. Mayer Jun. 1992 47 p
(AD-A259084) Avail: CASI HC A03/MF A01

This publication lists citations of all unclassified research reports, special reports, monographs, joint reports, journal articles, and proceedings that were published by the Naval Aerospace Medical Laboratory during calendar years 1977 through 1991. Reprint requests should be addressed to the Defense Technical Information Center, Cameron Station, Alexandria, VA 22314. GRA

N93-20549# Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
INFORMATION BASE PROCEDURES FOR GENERATION OF SYNTHETIC THERMAL SCENES Final Report
M. R. Kress Sep. 1992 36 p
(AD-A259202; WES-TR-EL-92-31) Avail: CASI HC A03/MF A01

Procedures are being developed for computer generation of thermal images that depict realistic landscape perspective and are radiometrically correct. Digital three-dimensional (3-D) representations of thermal terrain conditions can be used for software and hardware in the loop testing by weapons system designers, developers, and evaluators. The procedure has four components: (1) environmental information bases that characterize the static and dynamic aspects of the landscape, (2) physics-based numerical thermal prediction models, (3) radiance prediction models, and (4) computer graphics system for generating a 3-D thermal landscape perspective. The information base content, structure, and analysis methods developed to store and access 3-D terrain, weather, physical, thermal, and spectral property data required to support all procedure components are described. Methods for characterizing and quantifying environmental information as a 3-D dynamic landscape; formatting, managing, and retrieving diverse environmental information for numerical modeling purposes; environment, relational database, geographic information system, synthetic image, radiance, thermal, and analyzing terrain data are discussed. The spatial elements of the landscape are configured in a geographic information system and define the 3-D aspects of the environment. Physical, spectral, and thermal properties of the spatial elements are configured in a relational database management system integrated with the geographic information system. GRA

N93-20565# Electronics Research Lab., Adelaide (Australia).
DISTRIBUTED DATABASE MANAGEMENT EVALUATION SOFTWARE
S. J. Miller Aug. 1992 16 p
(AD-A259215; ERL-0635-RN; DODA-AR-006-977) Avail: CASI HC A03/MF A01

Techniques for assessing the performance of Distributed DataBase Manager (DDBN) systems are described. Both qualitative and quantitative methods of assessment are addressed. The desirability of collecting data from a test-bed system for use in the evaluation is highlighted. Finally, a functional requirement for a Distributed DataBase Management Evaluation Software (DBMES) package to be developed for the Distributed Processing Test-Bed System (DPTBS) is presented. GRA

N93-20602*# NASA Center for AeroSpace Information, Baltimore-Washington International Airport, MD.
NASA THESAURUS COMBINED FILE POSTINGS STATISTICS Cumulative Report, Jan. 1968 - Jan. 1993
Jan. 1993 352 p
(NASA-CR-192259; NAS 1.26:192259) Avail: CASI HC A16/MF A03

The NASA Thesaurus Combined File Postings Statistics is published semiannually (January and July). This alphabetical listing of postable subject terms contained in the NASA Thesaurus is used to display the number of postings (documents) indexed by each subject term from 1968 to date. The postings totals per item are separated by announcement of other media into STAR, IAA, COSMIC, and OTHER, columnar entries covering the NASA document collection (1968 to date). This is a cumulative publication, and except for special cases, no reference is needed to previous issuances. Retention of the January 1992 issue could be helpful for book information. With the July 1992 issue, NALNET book statistics have been replaced by COSMIC statistics for NASA funded software. File postings statistics for the Alternate Data Base covering NASA collection from 1962 through 1967 were published on a one-time basis in September 1975. Subject terms for the Alternate Data Base are derived from the subject Authority List, reprinted 1985, which is available upon request. The distribution of 19,697,748 postings among the 17,446 NASA Thesaurus terms is tabulated on the last page of the NASA Thesaurus Combined File Postings Statistics. Derived from text

N93-20611# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
DESIGN RECOVERY FOR SOFTWARE LIBRARY POPULATION M.S. Thesis
Chester A. Wright, Jr. Dec. 1992 92 p
(AD-A259292; AFIT/GCS/ENG/92D-23) Avail: CASI HC A05/MF A01

This thesis research investigated design recovery as a means of populating a reuse library. The targeted library was part of the Automatic Programming Technologies for Avionics Systems (APTAS). APTAS uses a knowledge base of forms, to present questions to a user, and rules, to select the forms to present and choose existing library modules to use in composing a new system. The approach applied the reengineering model developed in earlier work to accomplish planning for the project, expanded the renovation phase of this model to cover the actual design recovery, and applied the expanded model to populating the library. Using the model in the project showed that design recovery is feasible in populating the library. However, if the recovered design could not be used directly, it could be used as a guide in developing new components. Additionally, certain modules make better candidates than others. Ideal candidates are self-contained in that they receive a value, perform a computation, and return a value. Once the module starts performing too many operations, expertise is required in the module behavior in order to separate the component for reuse. GRA

N93-20734# Rolls-Royce Ltd., Derby (England).
HANDLING AND USING INFORMATION SYSTEMS WITH NEW TECHNOLOGY
A. A. Aitken 1 Nov. 1991 9 p
(PNR-90910; ETN-92-92760) Copyright Avail: CASI HC A02/MF A01

The action and planning carried out by an engine manufacturer, to take advantage of the advances available in order to provide maintenance information in a manner which reduces the efficiency of those using the information, and permits interactive use of data from multiple databases, are addressed. The method chosen to carry information is described and the benefits gained from a compact data storage medium capable of being accommodated and utilized on low cost hardware platforms, are outlined. In portraying the activities, the preparatory background necessary to arrive at today's achievement and the potential available as a result are discussed. The route ahead is examined and further advances are discussed. ESA

N93-20917# National Aerospace Lab., Amsterdam (Netherlands). Space Div.
DATA HANDLING IN TELESCIENCE EXPERIMENTS USING THE PROTOTYPE OPTICAL DIAGNOSTIC INSTRUMENT (PODI)
E. A. Kuijpers and R. Born (Dornier System G.m.b.H., Friedrichshafen, Germany.) 24 Oct. 1990 15 p Presented at 41st International Astronautical Congress, Dresden, Germany, Oct. 1990 Previously announced in IAA as A91-13741 Submitted for publication Sponsored in part by Netherlands Agency for Aerospace Programs
(NLR-TP-90327-U; ETN-92-92862) Avail: CASI HC A03/MF A01

A breadboard called PODI was developed following a study in a general facility for experimental research on fluid physics in a space laboratory. The breadboard was extended to TelePODI (Telescience PODI) for the study of telescience and image processing in 'microgravity related instrumentation' and was integrated in a telescience test bed. Some results of the integration, the telescience experiment preparation, and execution are reported. The experiments are related to ground simulations which resulted in an emphasis on data handling aspects. ESA

N93-20920*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

THE FY 1992 SCIENTIFIC AND TECHNICAL REPORTS, ARTICLES, PAPERS, AND PRESENTATIONS

Joyce E. Turner, comp. Oct. 1992 70 p

(NASA-TM-108392; NAS 1.15:108392) Avail: CASI HC A04/MF A01

This document presents formal NASA technical reports, papers published in technical journals, and presentations by MSFC personnel in FY92. It also includes papers of MSFC contractors. After being announced in STAR, all of the NASA series reports may be obtained from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The information in this report may be of value to the scientific and engineering community in determining what information has been published and what is available. Author

N93-20952# Beleidscommissie Remote Sensing, Delft (Netherlands).

PRODUCT DEVELOPMENT OF A USER INTERFACE FOR GEOGRAPHIC INFORMATION SYSTEMS (GIS) AND REMOTE SENSING FOR TRAINING PURPOSES [PRODUKTONTWIKKELING VAN EEN USER-INTERFACE VOOR GIS EN REMOTE SENSING VOOR OPLEIDINGSDOELEINDEN]

R. Beck (DHV Consultants, Malang, Indonesia.), P. J. vandenBoogaard (DHV Consultants, Malang, Indonesia.), N. J. Mulder (International Inst. for Aerospace Survey and Earth Sciences, Enschede, Netherlands.), H. R. Kostwinder (International Inst. for Aerospace Survey and Earth Sciences, Enschede, Netherlands.), and L. J. Blesius (International Inst. for Aerospace Survey and Earth Sciences, Enschede, Netherlands.) Mar. 1992 18 p In DUTCH

(BCRS-90-32; ISBN-90-5411-031-7; ETN-93-91870) Avail: CASI HC A03/MF A01

A user interface for Geographic Information Systems and remote sensing was developed with a view to the training of future users and in particular students. A market exploration and a definition of the interested groups and their specific requirements are outlined. The selected hardware and software are discussed. The product development plan in given. The different forms of user interface and possible tasks are depicted. In general, the reactions of future users were positive or very positive. It is concluded that the developed user interface meets a demand, and that further development is desired. ESA

N93-20955# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

ON SEMANTICS: THE CASE OF KNOWLEDGE GRAPHS

Cornelis Hoede Jan. 1992 24 p

(MEMO-1028; ETN-93-92456) Avail: CASI HC A03/MF A01

The concept of semantics is discussed. Formal or logical semantics is compared with subjective semantics. The two sided nature of a model used in knowledge representation is underlined. This supports the case of knowledge graphs. A short account of the theory of knowledge graphs is given. ESA

N93-21012# National Inst. of Standards and Technology, Gaithersburg, MD. Manufacturing Engineering Lab.

USER'S GUIDE TO THE ON-LINE BIBLIOGRAPHIC REFERENCE SYSTEM FOR THE NIST PROCESS PLANNING TESTBED

Allison Barnard Feeney 3 Aug. 1992 13 p

(DARPA Order 8609)

(PB92-226307; NISTIR-4891) Avail: CASI HC A03/MF A01

The National Institute of Standards and Technology (NIST) is in the process of establishing a testbed which will serve the research and information needs of the process planning community. Part of this testbed is an on-line annotated bibliographic service dedicated to process planning publications. The document provides the information necessary for one to become a registered user and begin using this service. It also provides information on interfacing with the software; i.e., the specific commands and syntax for writing queries, commenting on and scoring citations, as well as using the on-line documentation. Policies and procedures regarding the submission of new citations, inclusion of citations, editing, commenting, and scoring of citations are also provided in the text. GRA

N93-21032# Universiteit Twente, Enschede (Netherlands). Faculty of Applied Mathematics.

MODELLING KNOWLEDGE IN ELECTRONIC STUDY BOOKS

Cornelis Hoede Jan. 1992 14 p

(MEMO-1029; ETN-93-92457) Avail: CASI HC A03/MF A01

The theory of knowledge graphs is outlined. Knowledge graphs are a new form of knowledge representation. They are closely related to semantic networks and can be looked upon as in line with Schank's conceptual dependency theory and Sowa's conceptual graphs. The special feature of knowledge graphs is the use of a very restricted set of types of relations, that is considered to be the basic set of primitive relations. The possibilities of knowledge graphs for solving problems arising around electronic (study) books are discussed. ESA

N93-21218# National Inst. of Standards and Technology, Gaithersburg, MD. Fabrication Technology Div.

STEP DEVELOPMENT METHODS: SPECIFICATION OF SEMANTICS FOR INFORMATION SHARING

William F. Danner and Yuhwei Yang Sep. 1992 26 p Prepared in cooperation with Product Data Integration Technology, Long Beach, CA

(PB93-113686; NISTIR-4915) Avail: CASI HC A03/MF A01

The document describes the information sharing requirements and approaches used to fulfill those requirements in the development of standardized data constructs for the Standard for the Exchange of Product Model Data (STEP). It also describes the architecture used to conceptually organize the data constructs, and the information sharing architecture in which the standardized constructs are used. GRA

N93-21226# Executive Office of the President, Washington, DC. Office of Administration.

PUBLICATIONS OF THE EXECUTIVE OFFICE OF THE PRESIDENT Report, 20 Jan. 1989 - 30 Sep. 1992

30 Sep. 1992 16 p

(PB92-233204) Avail: CASI HC A03/MF A01

The report lists publications of the Executive Office of the President for the period January 20, 1989-September 30, 1992 for the Bush Administration. Author (GRA)

N93-21344# National Inst. of Standards and Technology, Gaithersburg, MD. Office of Information Services.

PUBLICATIONS OF THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY 1991 CATALOG Report, Jan. - Dec. 1991

Ernestine T. Gladden, ed. Jun. 1992 443 p

(PB92-217579; NIST/SP-305-Suppl-23) Avail: CASI HC A19/MF A04; SOD HC

The 23rd Supplement to Special Publication 305 contains full bibliographic citations including keywords and abstracts for National Institute of Standards and Technology (NIST) 1991 papers published and entered into the National Technical Information Service (NTIS) collection. Also included are NBS/NIST papers published prior to 1991, but not reported in previous supplements of the annual catalog. Four indexes are included to allow the user to identify NBS/NIST papers by personal author, keywords, title, or NTIS/order report number. GRA

N93-21379# National Commission on Libraries and Information Science, Washington, DC.

OPEN FORUM ON RECOMMENDATIONS OF THE WHITE HOUSE CONFERENCE ON LIBRARY AND INFORMATION SERVICES

1992 285 p Conference held in Washington, DC, 10 Mar. 1992

(PB93-107639; ISBN-0-16-037917-2) Avail: CASI HC A13/MF A03

The report presents open forum transcripts and written statements on recommendations of the White House Conference on Library and Information Services. GRA

N93-21380# General Accounting Office, Washington, DC. Information Management and Technology Div.

INFORMATION DISSEMINATION: INNOVATIVE WAYS AGENCIES ARE USING TECHNOLOGY

Jack L. Brock, Jr. 1992 14 p

(PB93-108462; GAO/T-IMTEC-92-6) Avail: CASI HC A03/MF A01; also available from GAO, PO Box 6015, Gaithersburg, MD 20877

The report presents congressional testimony on how some agencies

are using technology to provide the public with cheaper, faster access to a wider range of information. The applications discussed were developed using compact disc-read only memory (CD-ROM), bulletin board systems, voice messaging/facsimile, and floppy disks. The information is based primarily on interviews with users and developers of these applications and on a review of related documents. GRA

N93-21387# National Inst. of Standards and Technology, Gaithersburg, MD. Office of Information Services.

DATABASES AVAILABLE IN THE RESEARCH INFORMATION CENTER OF THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

Diane Cunningham Sep. 1992 146 p

(PB93-114478; NIST/SP-842) Avail: CASI HC A07/MF A02

Databases available online in the Research Information Center of the National Institute of Standards and Technology (NIST) are listed by acronym and by full title. In addition, descriptions of the databases, dates covered, producers, hard copy counterpart, principal sources, and vendors are listed. A general subject index, a cross reference index, and a fulltext database list are also supplied. GRA

N93-21475# National Oceanic and Atmospheric Administration, Boulder, CO. Wave Propagation Lab.

ADVANTAGES OF TAPERING FINITE DATA RECORDS FOR SPECTRAL ANALYSIS Technical Memo

L. Kristensen, P. Kirkegaard, C. W. Fairall, J. C. Kaimal, and D. H. Lenschow Sep. 1992 45 p Prepared in cooperation with Risoe National Lab.

(PB93-116614; NOAA-TM-ERL-WPL-226) Avail: CASI HC A03/MF A01

The authors discuss in general the relation between the 'true' spectrum of stationary times series of infinite duration and that obtained by digital computation from discretely sampled, real time-series of finite duration. In particular, the authors investigate the effect of an arbitrary time weighting function h(t) applied to the time series (tapering) and illustrate the results by comparing the effect of Hanning tapering with the effect of no tapering in the idealized case of a time series with a power-law spectrum. The main conclusion is that the spectrum will be seriously distorted without tapering if it falls off with a power greater than 2, and that a Hanning window will restore most of the true spectrum, with the exception of perhaps the first few harmonics, for powers in the interval from +1 to -3, provided the computed spectrum is renormalized by the area under the square of h(t). The authors also found that in the case when the spectrum falls off with a power greater than 1 the renormalization will be different from the ratio between the variance calculated with and without Hanning tapering. The authors' predictions are verified using synthetic time series. GRA

N93-21500# Office of Management and Budget, Washington, DC.

CURRENT INFORMATION TECHNOLOGY RESOURCE REQUIREMENTS OF THE FEDERAL GOVERNMENT, FY 1993

Aug. 1992 447 p

(PB92-233238; ISBN-0-16-037894-X) Avail: CASI HC A19/MF A04; SOD HC

The document is based on information submitted in support of the Budget of the United States Government--Fiscal Year 1993, and consists of a compilation of individual Federal Agency information technology acquisition plans for the fiscal years 1992 through 1997. A government-wide summary of agency spending data on information technology (IT) was added to this year's report. The summary highlights those agencies that proposed significant IT investments in the Fiscal Year 1993 Budget and also includes a historical examination of Federal IT spending trends. GRA

N93-21504# National Inst. of Standards and Technology, Gaithersburg, MD.

THE FIRST CENSUS OPTICAL CHARACTER RECOGNITION SYSTEM CONFERENCE

R. Allen Wilkinson, Jon Geist, Stanley Janet, Patrick J. Grother, Christopher J. C. Burges, Robert Creecy, Bob Hammond, Jonathan J. Hull, Norman W. Larsen, and Thomas P. Vogl et al Sep. 1992 376 p Conference held in Gaithersburg, MD, May 1992

(PB92-238542; NISTIR-4912) Avail: CASI HC A17/MF A03

The First Census Optical Character Recognition (OCR) Systems Conference tested a number of systems developed by different commercial, educational, and government organizations in the OCR of segmented hand-printed digits, upper case letters, and lower case letters. This report discusses the results, conclusions, and open questions of the conference. GRA

N93-21694# National Weather Service, Fort Worth, TX.

EXPANDED USER'S DOCUMENTATION FOR SHIMS Technical Memo

David B. Reed Oct. 1992 71 p

(PB93-101905; NOAA-TM-NWS-SR-143) Avail: CASI HC A04/MF A01

The publication is intended to provide a user-oriented instruction set for NWS-SR application of the Service Hydrologist Information Management System (SHIMS) Version 3.11. SHIMS is a hydrologic database and accompanying database management system. SHIMS, running under the commercial database management system Paradox, can store information on cooperative observer sites, river gaging sites, and river forecast sites and print out forms needed for the hydrologic program at offices with hydrologic service area (HSA) responsibility. SHIMS was developed in Central Region by Mike Callahan, Service Hydrologist at WSFO Louisville, KY. It is an outstanding example of contemporary software applications. All furnished SHIMS software loads include documentation for which this document is intended to be a supplement. GRA

N93-21959# Pacific Northwest Lab., Richland, WA.

STATUS OF DOCUMENT SEARCH AND DATA QUALITY OBJECTIVE EFFORTS Letter Report

S. P. Gydesen Oct. 1992 20 p

(Contract DE-AC06-76RL-01830)

(DE93-003216; PNWD-2047-HEDR) Avail: CASI HC A03/MF A01

The purpose of this report is to document the status of the identification, search, retrieval, evaluation, declassification, and availability of the following: (1) Hanford-Site-originated operating information necessary to reconstruct radiation doses; and (2) monitoring information indicating concentrations of radioactive materials in the environment. All information needed to date to reconstruct the radiation doses has been identified, sought, retrieved, evaluated, declassified, and made available. Any data needed in the future that have not yet been found will be sought using the same search tree method used to identify the Hanford-Site-originated documents up to now. This search tree method has ensured that the data quality objective of completeness is met. Because there was a centralized list of documents for which we have technical indices, the documents through 1964 have been identified, and the document collections are considered as complete as possible. The collection of documents from 1965-1972 is complete for monthly average data but not to the same extent as for the years 1944-1964 where daily and sometimes hourly data are often available and for which a subject index is readily available. From 1965-1972 there were multiple contractors, each maintaining a separate document system with no detailed subject index for retrieval purposes. A HEDR Information Resources Tracking System (HIRTS) database was established of all documents identified as being of potential interest and/or use to dose reconstruction. The HIRTS contains more than 6000 citations with bibliographic information on each report, document number(s), author(s), title, date, document form (hard copy or microfilm), number of pages, location, public availability, and names of HEDR Project and TSP staff who have requested copies. DOE

N93-21973# Stanford Research Inst., Menlo Park, CA.

THE CHEETAH DATA MANAGEMENT SYSTEM

P. F. Kunz and G. B. Word Sep. 1992 4 p Presented at the 10th Conference on Computing in High Energy Physics, Annecy, France, 21-25 Sep. 1992

(Contract DE-AC03-76SF-00515)

(DE93-004010; SU-SLAC-PUB-5930; CONF-920966-3) Avail: CASI HC A01/MF A01

Cheetah is a data management system based on the C programming language, with support for other languages. Its main goal is to transfer data between memory and I/O streams in a general way. The streams are either associated with disk files or are network data stems. Cheetah provides optional convenience functions to assist in the management of C structures. Cheetah streams are self-describing so that general purpose applications can fully understand an incoming stream. This information can be used to display the data in an incoming stream to the user of an interactive general application, complete with variable names and optional comments. DOE

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

N93-21358# General Accounting Office, Washington, DC. National Security and Internal Affairs Div.
NASA PROGRAM COSTS: SPACE MISSIONS REQUIRE SUBSTANTIALLY MORE FUNDING THAN INITIALLY ESTIMATED. REPORT TO THE CHAIRMAN, SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT, COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY, HOUSE OF REPRESENTATIVES
Dec. 1992 22 p
(GAO/NSIAD-93-97; B-251430) Avail: CASI HC A03/MF A01; GAO, PO Box 6015, Gaithersburg, MD 20877 HC

This report responds to a request to provide information on the National Aeronautics and Space Administration's (NASA) historical experience at estimating space program costs. The Subcommittee was concerned that at the time Congress is asked to authorize the start of new programs estimated to cost hundreds of millions or even billions of dollars, NASA may not have reasonably accurate estimates of their total funding requirements. Specifically, we reviewed the changes from initial to current estimates for major space programs initiated in the past 15 years and studied the reasons for those changes. Almost all of the 29 programs we reviewed required substantially more funding than the initial estimates provided to Congress. Changes in estimates ranged from a 44-percent decrease to a 426-percent increase over the initial estimates. The median change was a 77-percent increase. General reasons NASA gave for differences between the initial and current estimates included insufficient definition studies, program and funding instability, overoptimism by program officials, and unrealistic contractor estimates. Specific reasons for changes in estimates included program redesigns, technical complexities, budget constraints, incomplete estimates, shuttle launch delays, and inflationary effects. As a result of these factors, the content and schedule of many programs changed substantially between the initial and current cost estimates.
Derived from text

N93-21690# National Inst. of Standards and Technology, Gaithersburg, MD. Office of Applied Economics.
PRESENT WORTH FACTORS FOR LIFE-CYCLE COST STUDIES IN THE DEPARTMENT OF DEFENSE Final Report
Stephen R. Petersen Oct. 1992 61 p Sponsored by Assistant Secretary of Defense (Production and Logistics), Washington, DC
(PB93-120772; NISTIR-4942) Avail: CASI HC A04/MF A01

The document provides 45 tables of present worth factors to be used in computing the present worth of future costs (or cost reductions) in economic analyses of design decisions for projects in the DoD Military Construction Program. These factors are especially useful for the life-cycle cost analysis of investments in buildings or building systems which are intended to reduce future operating, maintenance, repair, replacement, and energy costs over the life of the facility. The tables include present worth factors for both one-time costs and annually recurring costs, based on the FEMP discount rate of 4.0 percent (FY 1993) for energy-related studies and on the OMB discount rate of 10.0 percent for non-energy studies. Forecasts of future energy prices used in the calculation of present worth factors for energy costs were provided by the Energy Information Administration. GRA

N93-21755# Clemson Apparel Research, Pengleton, SC.
INTEGRATED COST ACCOUNTING SYSTEM Final Report, Sep. 1988 - Jun. 1991
Mary A. Prater 27 Jul. 1992 120 p
(Contract DLA900-87-D-0017)
(AD-A258587) Avail: CASI HC A06/MF A02

The focus of this research was to develop an integrated shop floor management system for an Automated Apparel Manufacturing Facility. This report documents how this objective obtained by using the following approaches: (1) Program plan and schedule; (2) Examine CMM-I CMS for apparel application; (3) Develop an integrated product costing system for the AMMTD; (4) Implement the work in Clemson AAMTD; (5) Compare the IPCS to other traditional cost management systems; (6) Coordinate with other AAMTD projects; (7) Prepare briefing material. GRA

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

N93-21676# Committee on Appropriations (U.S. Senate).
DEPARTMENTS OF VETERANS AFFAIRS AND HOUSING AND URBAN DEVELOPMENT, AND INDEPENDENT AGENCIES APPROPRIATIONS FOR FISCAL YEAR 1993. PART 3: NONDEPARTMENTAL WITNESSES
Washington GPO 1992 411 p Hearings on H.R. 5679 before the Committee on Appropriations, 102d Congress, 2d Session, 22 May 1992
(S-Hrg-102-716-Pt-3; GPO-52-800; ISBN-0-16-039723-5) Avail: CASI HC A18/MF A04; Subcommittee on VA, HUD, and Independent Agencies, Senate, Washington, DC 20510; SOD HC

This volume is comprised of the Senate hearings before the Committee on Appropriations for the Departments of Veterans Affairs and Housing and Urban Development and independent agencies appropriations (including NASA) for the fiscal year 1993. Other scientific agencies included are the National Science Foundation and the Environmental Protection Agency. For individual titles, see N93-21677 through N93-21682.

N93-21677# Committee on Appropriations (U.S. Senate).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION: STATEMENT OF CHESTER LEE, SPACEHAB, INC.
In its Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations for Fiscal Year 1993. Part 3: Nondepartmental Witnesses 1992 p 187-190 (For primary document see N93-21676 07-84)
Avail: CASI HC A01/MF A04; Subcommittee on VA, HUD, and Independent Agencies, Senate, Washington, DC 20510; SOD HC

One of six sections of H.R. 5679 that are primarily concerned with NASA is presented. Testimony concerning the NASA budget for fiscal year 1993 is given. The specific budget item in question is the 51.4 million dollars that has been allocated for the Spacehab program. CASI

N93-21678# Committee on Appropriations (U.S. Senate).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION: STATEMENT OF JOANNE PADRON, AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS
In its Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations for Fiscal Year 1993. Part 3: Nondepartmental Witnesses 1992 p 198-200 (For primary document see N93-21676 07-84)
Avail: CASI HC A01/MF A04; Subcommittee on VA, HUD, and Independent Agencies, Senate, Washington, DC 20510; SOD HC

The second of six sections of H.R. 5679 that are primarily concerned with NASA is presented. Testimony concerning the NASA budget for fiscal year 1993 is given. A representative of the American Institute of Aeronautics and Astronautics (AIAA) provides testimony that argues for giving the NASA administrator a total budget limit as opposed to ceasing funding for individual programs. CASI

N93-21679# Committee on Appropriations (U.S. Senate).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION: STATEMENT OF RALPH J. STRNAD, SR., SECRETARY, WASHINGTON AREA METAL TRADES COUNCIL/CHIEF STEWARD, GODDARD SPACE FLIGHT CENTER
In its Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations for Fiscal Year 1993. Part 3: Nondepartmental Witnesses 1992 p 211-215 (For primary document see N93-21676 07-84)
Avail: CASI HC A01/MF A04; Subcommittee on VA, HUD, and Independent Agencies, Senate, Washington, DC 20510; SOD HC

The third of six sections of H.R. 5679 that are primarily concerned with NASA is presented. Testimony concerning the NASA budget for fiscal year 1993 is given. A representative of the Metal Trades Council provides testimony concerning the function of the Plant Operations and Maintenance Division (POMD) at GSFC. CASI

N93-21680# Committee on Appropriations (U.S. Senate).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION: STATEMENT OF MIGUEL A. HERNANDEZ, JR., HERNANDEZ ENGINEERING CO.
In its Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations for Fiscal Year 1993. Part 3: Nondepartmental Witnesses 1992 p 219-220 (For primary document see N93-21676 07-84)
Avail: CASI HC A01/MF A04; Subcommittee on VA, HUD, and Independent Agencies, Senate, Washington, DC 20510; SOD HC

The fourth of six sections of H.R. 5679 that are primarily concerned with NASA is presented. Testimony concerning the NASA budget for fiscal year 1993 is given. The topic of the testimony is the relationship that exists between NASA (specifically the Space Station Freedom program) and small businesses (specifically minority-owned businesses). CASI

N93-21681# Committee on Appropriations (U.S. Senate).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION: STATEMENT OF LEN RICKS, COUNCIL OF ENGINEERS AND SCIENTISTS ORGANIZATIONS
In its Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations for Fiscal Year 1993. Part 3: Nondepartmental Witnesses 1992 p 223-227 (For primary document see N93-21676 07-84)
Avail: CASI HC A01/MF A04; Subcommittee on VA, HUD, and Independent Agencies, Senate, Washington, DC 20510; SOD HC

The fifth of six sections of H.R. 5679 that are primarily concerned with NASA is presented. Testimony concerning the NASA budget for fiscal year 1993 is given. A representative of the Council of Engineers and Scientists Organization (CESO) provides testimony that argues for the continuance of the Space Station Freedom program. CASI

N93-21682# Committee on Appropriations (U.S. Senate).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION: STATEMENT OF THE SPACE SCIENCE WORKING GROUP
In its Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations for Fiscal Year 1993. Part 3: Nondepartmental Witnesses 1992 p 365-368 (For primary document see N93-21676 07-84)
Avail: CASI HC A01/MF A04; Subcommittee on VA, HUD, and Independent Agencies, Senate, Washington, DC 20510; SOD HC

The last of six sections of H.R. 5679 that are primarily concerned with NASA is presented. Testimony concerning the NASA budget for fiscal year 1993 is given. A representative of the Space Science Working Group (SSWG) provides testimony concerning the loss of funding for individual programs such as the Space Infrared Telescope Facility (SIRTF) and the Comet Rendezvous-Asteroid Flyby (CRAF). CASI

N93-21758# Carnegie Commission on Science, Technology, and Goverment, New York, NY.
SCIENCE AND TECHNOLOGY IN US INTERNATIONAL AFFAIRS
Rodney W. Nichols, Jesse H. Ausubel, and Jeannette Lindsay Aspden, ed. Jan. 1992 125 p
(ISBN-1-881054-00-4) Avail: CASI HC A06/MF A02

Publication of this report is one of several activities of the Carnegie Commission aimed at strengthening the institutions and decision-making processes through which science and technology are wisely and effectively applied to world affairs. On the one hand, these activities address the way in which the United States is organized within its own government for improving the applications of science and technology in international affairs. On the other hand, these activities also seek to renew a positive, long-range vision of the international institutional infrastructure for science and engineering in which the United States is a partner. In the forthcoming reports the Commission will emphasize two major areas of concern: development of the less-advanced nations of the world, and how all countries work together multilaterally on matters of common interest involving science and technology, such as global environmental change. Derived from text

N93-21287# Ministry of Posts and Telecommunications, Tokyo (Japan).
PARTNERS [PARTNERS KEIKAKU: HAN TAIHEIYOU JOUHOU TSUUSHIN NETTO WAKU JIKKEN KEIKAKU]
Kiyoshi Ooida *In* Science and Technology Agency, Pre Asia Pacific ISY Conference 23 Mar. 1992 p 76-77 In JAPANESE (For primary document see N93-21270 07-43)
Avail: CASI HC A01/MF A01

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

No abstracts in this category.

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N93-20541# European Space Agency, Paris (France).
IUE-ULDA ACCESS GUIDE NO. 3: INTERNATIONAL ULTRAVIOLET EXPLORER-UNIFORM LOW DISPERSION ARCHIVE: NORMAL GALAXIES
Giuseppe Longo, comp. (Osservatorio Astronomico, Capodimonte, Naples, Italy.) and Massimo Capaccioli, comp. (Padua Univ., Italy.) Apr. 1992 228 p
(ESA-SP-1152; ISBN-92-9092-045-9; ETN-93-93043) Copyright Avail: CASI HC A11/MF A03

All International Ultraviolet Explorer (IUE) low dispersion spectra of non active galaxies contained in the IUE Uniform Low Dispersion Archive (ULDA) were analyzed to produce a homogeneous set of ultraviolet energy distributions. These are presented in this guide which is divided into two parts: an introduction including detailed information on the individual objects and an atlas of dereddened ultraviolet spectral energy distribution. Notes to the objects and references to papers in which published observations and discussion of IUE observations have appeared, are given in the appendixes. ESA

N93-20746*# Smithsonian Astrophysical Observatory, Cambridge, MA.
VERY HIGH ENERGY GAMMA RAY EXTENSION OF GRO OBSERVATIONS Semiannual Status Report No. 3, 1 Jul. - 31 Dec. 1991
Trevor C. Weekes Feb. 1992 46 p
(Grant NAG5-1381)
(NASA-CR-192407; NAS 1.26:192407) Avail: CASI HC A03/MF A01

This has been an exiciting year for high energy gamma-ray astronomy, both from space and from ground-based observatories. It has been a particularly active period for the Whipple Observatory gamma-ray group. In phase 1 of the Compton Gamma Ray Observatory (GRO), there has not been too much opportunity for overlapping observations with the Energetic Gamma Ray Experiment Telescope (EGRET) and the other GRO telescopes; however, significant progress was made in the development of data analysis techniques and in improving the sensitivity of the technique which will have direct application in correlative observations in phase 2. Progress

made during the period 1 Jul. 1991 - 31 Dec. 1991 is presented.
Derived from text

N93-20793*# Smithsonian Astrophysical Observatory, Cambridge, MA.
THE EINSTEIN ALL-SKY SLEW SURVEY Final Report, 1 Aug. 1989 - 31 Jul. 1991
Martin S. Elvis May 1992 85 p
(Grant NAG5-1201)
(NASA-CR-192323; NAS 1.26:192323) Avail: CASI HC A05/MF A01

The First Einstein IPC Slew Survey produced a list of 819 x-ray sources, with f(sub x) approximately 10(exp -12) - 10(exp -10) erg/sq cm s and positional accuracy of approximately 1.2 feet (90 percent radius). The aim of this program was to identify these x-ray sources. For individual titles, see N93-20794 through N93-20796.

N93-20794*# Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.
IDENTIFICATIONS OF EINSTEIN SLEW SURVEY SOURCES
Jonathan F. Schachter, Martin S. Elvis, David Plummer, and G. Fabbiano *In* Smithsonian Astrophysical Observatory, The Einstein All-Sky Slew Survey May 1992 8 p (For primary document see N93-20793 07-89)
Avail: CASI HC A02/MF A01

The status of identifications of the Einstien Slew Survey, a bright soft x-ray catalog with 550 new x-ray sources, is discussed. Possible counterparts were found for greater than 95 percent of the Slew Survey based on positional coincidences and color-color diagnostics. The survey will be fully identified via upcoming radio and optical observations. Author

N93-20795*# Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.
EINSTEIN SLEW SURVEY: DATA ANALYSIS INNOVATIONS
Martin S. Elvis, David Plummer, Jonathan F. Schachter, and G. Fabbiano *In* Smithsonian Astrophysical Observatory, The Einstein All-Sky Slew Survey May 1992 3 p (For primary document see N93-20793 07-89)
Avail: CASI HC A01/MF A01

Several new methods were needed in order to make the Einstein Slew X-ray Sky Survey. The innovations which enabled the Slew Survey to be done are summarized. These methods included experimental approach to large projects, parallel processing on a LAN, percolation source detection, minimum action identifications, and rapid dissemination of the whole data base. Author

N93-20796*# Harvard-Smithsonian Center for Astrophysics, Cambridge, MA.
THIRTEEN NEW BL LACERTAE OBJECTS DISCOVERED BY AN EFFICIENT X RAY/RADIO/OPTICAL TECHNIQUE
Jonathan F. Schachter, John T. Stocke (Colorado Univ., Boulder.), Eric Perlman (Colorado Univ., Boulder.), Martin S. Elvis, Jane Luu, John P. Huchra, Roberta Humphreys (Minnesota Univ., Minneapolis.), Ron Remillard (Massachusetts Inst. of Tech., Cambridge.), and John Wallin (Naval Research Lab., Washington, DC.) *In* Smithsonian Astrophysical Observatory, The Einstein All-Sky Slew Survey May 1992 18 p (For primary document see N93-20793 07-89)
Avail: CASI HC A03/MF A01

The discovery of 13 serendipitous BL Lac objects in the Einstein IPC Slew Survey by means of x ray/radio vs. x ray/optical color-color diagrams and confirmation by optical spectroscopy are reported. These 13 BL Lacs were discovered using a technique which exploits the characteristic broad band spectra of BL Lacs. New VLA detections provide accurate fluxes (f(6 cm) is approximately 0.5 mJy) and 2 in. positions, facilitating the determination of an optical counterpart. All 13 new BL Lacs show essentially featureless optical spectra. Nine of these lie within the range of colors of known x ray selected BL Lacs. Of the remaining four, one is apparently x ray louder (by a factor of 1.5) or optically quieter (by 0.8 mags); and three are optically louder (by 1-1.3 mags) than x ray selected BL Lacs. Approximately 50 new BL Lacs in total are expected from VLA work and upcoming Australia Telescope observations, yielding a complete Slew Survey sample of approximately 90 BL Lacs. Author

N93-21025# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
A NEW DECONVOLUTION METHOD FOR THE DOPPLER CARTOGRAPHY OF COOL STAR SURFACES AND ITS USE ON AB DORADUS Thesis - Ludwig-Maximilians-Univ. [EINE NEUE ENTFALTUNGSMETHODE FUER DIE DOPPLER-KARTOGRAPHIERUNG VON OBERFLAECHEN KUEHLER STERNE UND IRHE ANWENDUNG AUF AB DORADUS]
Martin Kuerster Mar. 1992 282 p In GERMAN Sponsored by DFG
(MPE-236; ETN-93-92594) Copyright Avail: CASI HC A13/MF A03

The development of methods for the mapping of stellar surface structures, in particular the mapping of photospheric star spot distributions on active cool stars is dealt with. Procedures of extracting information from the observational data are studied. Major attention is given to the 'Doppler imaging Method,' which enables the observer to produce detailed two dimensional images of the photospheres of rapidly rotating stars. The basis of the method is the deprojection and deconvolution of rotationally broadened profiles of stellar absorption lines. The constraint adopted consists of trying to find a 'two temperature model' of the stellar photosphere. The developed method is applied to recent observations of the rapidly rotating premain sequence star AB Doradus. ESA

N93-21052# Astronomische Rechen-Inst., Heidelberg (Germany).
CORRECTIONS TO THE LUNI-SOLAR PRECESSION DERIVED FROM A COMPILATION CATALOGUE OF EXTRAGALACTIC RADIO SOURCES
H. G. Walter 1991 10 p Repr. from Celestial Mechanics and Dynamical Astronomy (Netherlands, Kluwer Academic Publishers), v. 53, 1992 p 71-80 Previously announced in IAA as A92-41069
(Mitt-Ser-A-233; ETN-93-93404) Avail: CASI HC A02/MF A01

Setting up a compilation catalog of positions from observation catalogs of extragalactic radio sources by simultaneous solution of systematic catalog corrections and source coordinate corrections was proved to be a feasible method. This method was compared with the independent Very Long Baseline Interferometry (VLBI) compilation catalog of the International Earth Rotation Service (IERS) and deviations of 2 to 3 mas in Right Ascension (RA) and Declination (Dec) were found. The average external accuracy is reflected by the weighted rms differences amounting to about 1 mas in both coordinates. By including terms of general precession in RA and Dec in the method of simultaneous solution, uncertainties of the standard model of precession could be made evident. Corrections to the luni-solar precession of -1 and -3 mas/yr were derived which are compatible with results obtained by other methods of data analysis. ESA

N93-21299# Astronomische Rechen-Inst., Heidelberg (Germany).
PRESENT STATUS OF WORK ON THE FK5 EXTENSION
Thomas E. Corbin (Naval Observatory, Washington, DC.) and Heiner Schwan 1990 4 p Repr. from Reference Systems. Proceedings of the 127th Colloquium of the IAU, Virginia Beach, VA, 14-20 Oct. 1990 (Naval Observatory), 1991 p 238-241
(Mitt-Ser-B-229; ETN-93-93403) Avail: CASI HC A01/MF A01

The construction of the Fifth Fundamental Catalog (FK5) is described and its main characteristics are given. The FK5 extension, consisting of 3117 new fundamental stars selected from the FK4 Sup catalog and the International Reference Stars (IRS) list, will extend the FK5 system to about 9.5th visual magnitude. The selection of the new fundamental stars and the derivation of mean positions and proper motions are discussed. ESA

N93-21670# Space Studies Inst., Princeton, NJ.
IMPROVING THE DETECTION OF NEAR-EARTH ASTEROIDS Final Report
Gregg E. Maryniak Dec. 1992 15 p
(Contract N00014-92-J-2007)
(AD-A259383) Avail: CASI HC A03/MF A01

Recent discoveries of near-Earth asteroids and growing validation of the asteroid theory of dinosaur extinction through mounting geological evidence have made the general public aware of the potential threat that these objects pose. Two recent NASA workshops have been conducted on how to detect potentially threatening celestrial objects and what to do, if and when, one is detected. Interest in detecting near-Earth asteroids goes beyond concerns of defense of our planet, however. These bodies, located outside of the deep gravity wells of planetary systems and large

moons are known to contain a variety of elements which could be used as building blocks for future space missions, at a fraction of the cost of Earth launch costs. Given the interest and utility of detecting these objects, the logical question is how to get from the present condition where a few individuals and organizations detect a dozen or so objects each year, to a comprehensive understanding of the locations and characteristics of the asteroid population in near-Earth space. Most importantly what steps can be taken immediately and with modest funding, prior to creating new large networks of asteroid search systems. Prospects for increasing our information significantly with modest funding are good. Modern techniques described within the report, as well as the zealous efforts of several observes, notably Helin and Gehrels, have produced many of the recent asteroid discoveries. For example, over two thirds of the known near-Earth asteroids have been found in the last fifteen years. GRA

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

For related information see also *75 Plasma Physics*.

N93-20047 Rice Univ., Houston, TX.
FIELD STAR INTERACTIONS WITH GLOBULAR CLUSTERS Ph.D. Thesis
Wei Peng 1992 137 p
Avail: Univ. Microfilms Order No. DA9234443

We investigate a new interaction of globular clusters with galactic field stars. By dynamical friction, high-velocity field stars passing through individual globular clusters are decelerated. This frictional interaction contributes to cluster heating, and, in conjunction with disk shocking and other mechanisms, it helps regulate the evolution of globular clusters. Moreover, penetrating field stars with low relative velocities can even be captured by globular clusters. Our calculated rate of captures suggest that there is a substantial population of stars having an origin external to the globulars in which they now reside. Intriguing candidates for this 'immigrant' population include some blue straggler stars and short-period pulsars. Dissert. Abstr.

N93-20269*# Lockheed Missiles and Space Co., Palo Alto, CA. Research Lab.
THEORETICAL STUDIES IN INTERSTELLAR CLOUD CHEMISTRY Final Report
Y. T. Chiu and S. S. Prasad 15 Jan. 1993 12 p
(Contract NASw-4638)
(NASA-CR-192010; NAS 1.26:192010) Avail: CASI HC A03/MF A01

This final report represents the completion of the three tasks under the purchase order no. SCPDE5620,1,2F. Chemical composition of gravitationally contracting, but otherwise quiescent, interstellar clouds and of interstellar clouds traversed by high velocity shocks, were modeled in a comprehensive manner that represents a significant progress in modeling these objects. The evolutionary chemical modeling, done under this NASA contract, represents a notable advance over the 'classical' fixed condition equilibrium models because the evolutionary models consider not only the chemical processes but also the dynamical processes by which the dark interstellar clouds may have assumed their present state. The shock calculations, being reported here, are important because they extend the limited chemical composition derivable from dynamical calculations for the total density and temperature structures behind the shock front. In order to be tractable, the dynamical calculations must severely simplify the chemistry. The present shock calculations take the shock profiles from the dynamical calculations and derive chemical composition in a comprehensive manner. The results of the present modeling study are still to be analyzed with reference to astronomical observational data and other contemporary model predictions. As far as humanly possible, this analysis will be continued with CRE's (Creative Research Enterprises's) IR&D resources, until a sponsor is found. Author

N93-20292 Stanford Univ., CA.
NON-TOPOLOGICAL SOLITONS IN ASTROPHYSICS AND COSMOLOGY Ph.D. Thesis
David Abraham Hochron 1992 58 p
Avail: Univ. Microfilms Order No. DA9234106

When evaluating the consequences of a field theory for the early universe or for present-day astrophysics, one must consider not only the elementary particles predicted by the theory, but also extended objects. Bulk solutions to classical field theories - solitons - arise naturally in many theories, including nuclear models. In the first part of this thesis I explore the evolution of non-topological solitons in the early universe, with application to the QCD phase transition. In the second part I examine a non-topological soliton model of neutron stars - the Q-star model - and restrict the model parameters from the existence of the fast pulsar and rotating fluid stability considerations. Dissert. Abstr.

N93-20757*# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
THE STRUCTURE OF CIRCUMSTELLAR SHELLS Final Technical Report, 1 Aug. 1989 - 31 Jan. 1992
John D. Fix 10 Mar. 1993 10 p
(Grant NAG5-1174)
(NASA-CR-192337; NAS 1.26:192337) Avail: CASI HC A02/MF A01

This document provides a report on research activities carried out with the support of NASA grant NAG 5-1174, the Structure of Circumstellar Shells, funded under the Astrophysics Data Program. The research carried out with the support of this grant is a study of the properties of circumstellar dust shells for which spectra are available through IRAS low resolution spectrometry (LRS). This research consisted of the development and application of models of axisymmetric circumstellar shells and a preliminary survey of the applicability of neural nets for analysis of the IRAS LRS spectra of circumstellar dust shells. Derived from text

N93-20849# Rome Univ. (Italy). Dipt. di Fisica.
GRAVITATIONAL METRIC DEVIATION BY SUPERNOVA NEUTRINO BURSTS
Daniele Fargion 22 Feb. 1991 11 p Submitted for publication
(Preprint-789; ETN-93-92899) Avail: CASI HC A03/MF A01

A small decaying blueshift in the photon frequencies emitted inside an expanding spherical symmetric energy shell is discussed. It can be considered as the gravitational signature of a supernova explosion and its neutrino burst propagation. Intersections near the supernova relic, such as collapse of the pulsar and doppler shifts, may influence and hide this gravitational effect. The effect might be observable as a heating process in the relic star temperature and as a speeding up evolution in its pulsar period at earliest stages. ESA

N93-20856# Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
NUMERICAL EXAMINATION OF KELVIN-HELMHOLTZ INSTABILITY WITH SELF GRAVITATION AND COSMOLOGIC EXPANSION: A CONTRIBUTION TO THE FORMATION OF STRUCTURE IN THE UNIVERSE Thesis - Ludwig-Maximilians-Univ. [NUMERISCHE UNTERSUCHUNG ZUR KELVIN-HELMHOLTZ-INSTABILITAET MIT SELBSTGRAVITATION UND KOSMOLOGISCHER EXPANSION: EIN BEITRAG ZUR ENTSTHUNG VON STRUKTUR IM UNIVERSUM]
Hans-Reinhard Mueller Apr. 1992 110 p In GERMAN
(MPE-238; ETN-93-92596) Copyright Avail: CASI HC A06/MF A02

A simulation program which solves the hydrodynamic fundamental equations and the Poisson equation of the gravitational field in a two dimensional field in time is presented. An analytical approximation and a simulation show that shear flows are unstable in these conditions for adiabatic perturbations. The development of the Kelvin-Helmholtz instability is examined without hydrodynamic pressure with regard to astrophysical applications in interstellar and intergalactic fields. Shear flows are examined in a Universe in expansion. It is shown that the Universe expansion exerts an attenuating influence on the development of small velocity perturbations which are perpendicular to shear flow. The examinations confirm the theory that small structures at first and greater structures, such as galaxies, later on, are formed. ESA

N93-21007# European Space Agency, Paris (France).
IUE-ULDA ACCESS GUIDE NO. 4A: INTERNATIONAL ULTRAVIOLET EXPLORER-UNIFORM LOW DISPERSION ARCHIVE ACTIVE GALACTIC NUCLEI, VOLUME A
Thierry J.-L. Courvoisier, comp. (Geneva Observatory, Switzerland.) and Stephane Paltani, comp. (Lausanne Univ., Switzerland.) Jul. 1992

431 p
(ESA-SP-1153-Vol-A; ISBN-92-9092-049-1; ETN-93-93500) Copyright Avail: CASI HC A19/MF A04

The ULDA access guide (volumes 4A and 4B) treats the data of Active Galactic Nuclei (AGN). An overview of the spectra of all AGN from narrow line emission line galaxies to quasars and BL Lacertae objects observed with IUE is presented. The sample of such objects presently included in the IUE archive and the variability characteristics of the objects are illustrated. Information on the data obtained of these objects with the various X-ray satellites operated in conjunction with the IUE science observing program is given. Both volumes explain the data processing, bibliography, discuss related X-ray observations, describe the displayed information and give notes on the problems related to a few individual objects encountered. Volume A presents the spectra of AGN for right ascension from 0:00 to 13:00. ESA

N93-21015# European Space Agency, Paris (France).
IUE-ULDA ACCESS GUIDE NO. 4B: INTERNATIONAL ULTRAVIOLET EXPLORER-UNIFORM LOW DISPERSION ARCHIVE ACTIVE GALACTIC NUCLEI, VOLUME B
Thierry J.-L. Courvoisier, comp. (Geneva Observatory, Switzerland.) and Stephane Paltani, comp. (Lausanne Univ., Switzerland.) Jul. 1992 425 p
(ESA-SP-1153-Vol-B; ISBN-92-9092-049-1; ETN-93-93501) Copyright Avail: CASI HC A18/MF A04

The ULDA access guide 4 (volumes 4A and 4B) treats the data of Active Galactic Nuclei (AGN). An overview of the spectra of all AGN from narrow line emission line galaxies to quasars and BL Lacertae objects observed with IUE is presented. The sample of such objects presently included in the IUE archive and the variability characteristics of the objects are illustrated. Information on the data obtained of these objects with the various X-ray satellites operated in conjunction with the IUE science observing program is given. Both volumes explain the data processing, bibliography, discuss related X-ray observations, describe the displayed information and give notes on the problems related to a few individual objects encountered. Volume B presents the spectra of AGN for right ascension from 13:00 to 24:00, the bibliography and X-ray spectra from the Einstein, Exosat, and Ginga satellites. ESA

N93-21196*# California Inst. of Tech., Pasadena. Div. of Physics, Mathematics, and Astronomy.
RESEARCH RELATIVE TO THE HEAVY ISOTOPE SPECTROMETER TELESCOPE EXPERIMENT Final Report, 1 Dec. 1985 - 30 Nov. 1992
Edward C. Stone and Richard A. Mewaldt 12 Mar. 1993 14 p
(Grant NAG5-722)
(NASA-CR-192357; NAS 1.26:192357) Avail: CASI HC A03/MF A01

The Heavy Isotope Spectrometer Telescope (HIST) was launched during August 1978 on ISEE-3 (ICE). HIST was designed to measure the isotopic composition of solar, galactic, and interplanetary cosmic ray nuclei for the elements from H to Ni (1 less than or equal to Z less than or equal to 28) in the energy range from approximately 5 to approximately 200 MeV/nucleon. The results of these measurements have been used in studies of the composition of solar matter and galactic cosmic ray sources, the study of nucleosynthesis processes, studies of particle acceleration and propagation, and studies of the life-history of cosmic rays in the heliosphere and in the galaxy. On December 1, 1978, after 110 days in orbit, HIST suffered an electronic failure in its readout system. After that point, only one-half of the telemetry bits associated with the pulse heights measured by HIST were transmitted to Earth. As a result, the resolution of HIST was significantly degraded, and it served as an element rather than an isotope spectrometer. Fortunately, HIST was able to measure the isotopic composition of heavy nuclei in the 9/23/78 solar event (the largest solar energetic particle event since 1972) during the brief period that it operated at full resolution. This grant funded the analysis of data from the HIST instrument over the period from 12/1/85 to 11/30/92. In section 2 of this final report, we summarize the scientific accomplishments that have resulted from HIST measurements during this time period. A bibliography of tasks and papers that resulted is attached. Derived from text

N93-21300# Astronomische Rechen-Inst., Heidelberg (Germany).
DYNAMICS OF STELLAR POPULATIONS IN GALACTIC DISKS
Roland Wielen, Christian Dettbarn, Burkhard Fuchs, Hartmut Jahreiss, and Gunnar Radons 1992 12 p Repr. from The Stellar Populations of Galaxies (Netherlands, IAU), 1992 p 81-92
(Mitt-Ser-A-234; ETN-93-93405) Copyright Avail: CASI HC A03/MF A01

Observational data and dynamical considerations on the age dependence of the spatial distribution and of the velocities of stars in disk galaxies (thick disk, thin disk, spiral arms) are discussed. New results on the age velocity relation, on the heating of a galactic disk by massive black holes, and on theoretically predicted luminosity and color profiles in edge on galaxies are presented. ESA

N93-21301# Astronomische Rechen-Inst., Heidelberg (Germany).
DISSOLUTION OF TIDALLY LIMITED STAR CLUSTERS IN GALAXIES BY PASSING GIANT MOLECULAR CLOUDS OR OTHER MASSIVE OBJECTS
Roland Wielen 1991 7 p Repr. from Astronomical Society of the Pacific Conference Series: The Formation and Evolution of Star Clusters (Astronomical Society of the Pacific), v. 13, 1991 p 343-349
(Mitt-Ser-A-232; ETN-93-93406) Avail: CASI HC A02/MF A01

A procedure to predict theoretically the total lifetime of a star cluster in a galaxy is presented. This procedure improves upon earlier results in so far as the effect of the stationary tidal field of the parent galaxy is also included into the process of the disruption of a cluster by passing massive objects, such as giant molecular clouds or massive black holes. While the stationary tidal field was already taken into account for the process of the evaporation of a star cluster due to its internal relaxation (encounters between cluster stars), the star cluster was treated, for simplicity, as an isolated system when the disruption of the cluster by passing objects was studied. The improved procedure gives more homogeneous results by taking into account the galactic tidal field for both internal and external processes of cluster dissolution. ESA

N93-21302# Astronomische Rechen-Inst., Heidelberg (Germany).
RECURRENT SWING AMPLIFICATION INDUCED BY NONLINEAR AMPLITUDE EFFECTS
Burkhard Fuchs 1991 5 p Repr. from Dynamics of Disc Galaxies (Goteborg, Sweden), 1991 p 359-363
(Mitt-Ser-A-230; ETN-93-93407) Avail: CASI HC A01/MF A01

First results of a study of the role of nonlinear amplitude effects of spiral density waves in the dynamics of disk galaxies are reported. The basic galactic model adapted is the stellar dynamical analogue of the Goldreich and Lynden Bell sheet which describes the local dynamics of a patch of a thin differentially rotating stellar disk. The disk is subjected to potential perturbations, and the response of the disk is calculated in linear approximation from linearized Boltzmann equation where H(sub 0) denotes the Hamiltonian of stellar orbits in the basic disk model. A Fourier Laplace transform of the potential perturbation leads to the disk response. In order to obtain self consistent perturbations the response density is inserted into the Poisson equation. Further details of the calculation are given. ESA

N93-21673# Lawrence Livermore National Lab., CA.
THE CRAB NEBULA'S WISPS AS SHOCKED PULSAR WIND
Y. A. Gallant, J. Arons, and A. B. Langdon 20 Jul. 1992 11 p Presented at the Physics of Isolated Pulsars Workshop, Taos, NM, 23-28 Feb. 1992
(Contract W-7405-eng-48)
(DE93-003466; UCRL-JC-111254; CONF-9202117-8) Avail: CASI HC A03/MF A01

The Crab synchrotron nebula has been successfully modelled as the post-shock region of a relativistic, magnetized wind carrying most of the spindown luminosity from the central pulsar. While the Crab is the best-studied example, most of the highest spindown luminosity pulsars are also surrounded by extended synchrotron nebulae, and several additional supernova remnants with 'plerionic' morphologies similar to the Crab are known where the central object is not seen. All these objects have nonthermal, power-law spectra attributable to accelerated high-energy particles thought to originate in a Crab-like relativistic pulsar wind. However, proposed models have so far treated the wind shock as an infinitesimally thin discontinuity, with an arbitrarily ascribed particle acceleration efficiency. To make further progress, investigations resolving the shock structure seemed in order. Motivated by these considerations, we have performed particle-in-cell (PIC) simulations of perpendicularly magnetized shocks in

electron-positron and electron-positron-ion plasmas. The shocks in pure electron-positron plasmas were found to produce only thermal distributions downstream, and are thus poor candidates as particle acceleration sites. When the upstream plasma flow also contained a smaller population of positive ions, however, efficient acceleration of positrons, and to a lesser extent of electrons, was observed in the simulations. DOE

N93-21775# Brookhaven National Lab., Upton, NY.
PHENOMENOLOGICAL CORRELATIONS IN NUCLEAR STRUCTURE: AN OPPORTUNITY FOR NUCLEAR ASTROPHYSICS AND A CHALLENGE TO THEORY
R. F. Casten and N. V. Zamfir 1992 19 p Presented at the Workshop on Nuclear Physics in the Universe, Oak Ridge, TN, 24-26 Sep. 1992
(Contracts DE-AC02-76CH-00016; DE-FG02-88ER-40417)
(DE93-003470; BNL-48044; CONF-9209239-2) Avail: CASI HC A03/MF A01

Though it often appears daunting in its complexity, nuclear data frequently exhibits remarkable simplicities when viewed from the appropriate perspectives. This realization, which is becoming more and more apparent, is one of the fruits of the vast amount of nuclear data that has been accumulated over many years but, surprisingly, has never been completely digested. This emerging, unified, and simple macroscopic phenomenology, aided by microscopic underpinnings and physical arguments, appears in many guises and often simplifies semi-empirical estimates of structure far from stability in the critical realms where nuclear astrophysics takes place and where it is in need for improved nuclear input. The generality of simple phenomenological relationships begs both for a sound theoretical basis and for the advent of Radioactive Nuclear Beams so that the reliability of their extrapolations can be assessed and tested. These issues will be discussed, and illustrated with a number of specific examples. DOE

N93-21849# Los Alamos National Lab., NM.
LUNAR AND ASTEROID COMPOSITION ASSESSMENT USING REMOTE SECONDARY ION MASS SPECTROMETRY
H. O. Funsten, R. C. Elphic, B. L. Barraclough, D. J. McComas, K. R. Moore, and J. E. Nordholt 1992 8 p Presented at the International Symposium on Spectral Sensing Research, Maui, HI, 15-20 Nov. 1992
(Contract W-7405-eng-36)
(DE93-003839; LA-UR-92-3789; CONF-9211130-2) Avail: CASI HC A02/MF A01

Compositional analysis of the Moon and asteroids is of scientific importance as a window into the formation and evolution of the solar system. Additionally, global geochemical surveys can be utilized to examine available resources for further exploration of the solar system. A quantitative analysis of a technique of elemental composition of planetary surfaces using remote secondary ion mass spectrometry (SIMS) is presented. Remote SIMS, in principle identical to laboratory SIMS, utilizes solar wind ions to sputter secondary ions from a planetary surface. The trajectories of these secondary ions are governed by local electric and magnetic fields. An ion mass spectrometer located on an orbiting platform detects these ions and evaluates their mass and velocity. The origin at the planetary surface of a detected ion is determined by its velocity at the orbiter and knowledge of the solar wind electric and magnetic fields. The elemental composition of the planetary surface is determined by comparison of the detected amounts of various elements. DOE

N93-21951 Max-Planck-Inst. fuer Extraterrestrische Physik, Garching (Germany).
HIGH RESOLUTION HI OBSERVATIONS OF HII REGIONS. 3: PHOTODISSOCIATION REGIONS AND THE MAGNETIC FIELD NEAR ORION B
P. P. Vanderwerf, W. M. Goss (National Radio Astronomy Observatory, Socorro, NM.), C. Heiles (California Univ., Berkeley.), R. M. Crutcher (Illinois Univ., Urbana.), and T. H. Troland (Kentucky Univ., Lexington.) May 1992 52 p Submitted for publication
(MPE-Preprint-214; ETN-93-93528) Copyright Avail: Fachinformationszentrum Karlsruhe, 7514 Leopoldschafen-Eggenstein 2, Germany

H1 observations of the H2 region Orion B are presented with an angular resolution of 50 inches (0.1 pc) and velocity resolution of 0.64 km/s. Three kinematically distinct H1 layers are detected in absorption. It is argued that one of these H1 components originates in a Photodissociation Region (PDR) directly abutting the ionization front in front of the H2 region. In addition to the H1 absorption, H1 emission is detected, most likely originating in a PDR behind the H2 region. Combining the H1 emission and absorption data yields the conclusion that a range of temperatures exists in the PDRs, a conclusion corroborated by existing (C2) 158 micrometer line measurements of the PDRs. While the H1 'absorption' data show the presence of gas colder than approximately 20K (which is too cold to contribute significantly to the (C2) emission), the H1 and (C2) data can be brought in agreement if the 'emitting' H1 is at a temperature of at least several hundred degrees. These results are interpreted in terms of a clumpy PDR model, where the colder gas is located in dense clumps, which are embedded in a warmer, low density interclump medium. Structural features in the absorbing H1 are consistent with the presence of a stellar wind shell from an O9 ZAMS star located in the H2 region core, in agreement with the ionization requirements of hydrogen and helium. An analysis of the Zeeman effect as determined from the observed circular polarization yields line of sight magnetic fields of 28 and 63 micro-g for two of the H1 layers, at a reduced angular resolution of 100 inches. The magnetic field strength and the total pressure in the dense PDR are concluded to be higher than in the more tenuous cloud envelope. However, in the cloud envelope the pressure is dominated by the magnetic field, while in the PDR turbulent pressure dominates. ESA

N93-21970# Los Alamos National Lab., NM.
NUMERICAL MODELS OF PLANETARY DYNAMOS
G. A. Glatzmaier and P. H. Roberts 1992 24 p Presented at the 1992 Studies of the Earth's Deep Interior Symposium, Mizusawa, Japan, 5-10 Jul. 1992
(Contract W-7405-eng-36)
(DE93-003848; LA-UR-92-3819; CONF-9207166-1) Avail: CASI HC A03/MF A01

A nonlinear, axisymmetric, spherical-shell model of planetary dynamos is described. This intermediate-type dynamo model requires a prescribed helicity field (the alpha effect) and a prescribed buoyancy force or thermal wind (the omega effect) and solves for the axisymmetric time-dependent magnetic and velocity fields. Three very different time dependent solutions are obtained from different prescribed sets of alpha and omega fields. DOE

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.

For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N93-19959*# Institute for Scientific Research, Lexington, MA.
THEORETICAL STUDIES OF IMPORTANT PROCESSES IN PLANETARY AND COMET ATMOSPHERES Semiannual Status Report, 1 Nov. 1990 - 30 Apr. 1991
Steven L. Guberman 30 Apr. 1991 11 p
(Grant NAGw-1404)
(NASA-CR-192114; NAS 1.26:192114) Avail: CASI HC A03/MF A01

This is the fifth semi-annual progress report describing research on dissociative recombination reactions in planetary and comet atmospheres. The Appendix has two papers that describe NASA supported research. Both papers have been recently accepted for publication. The first paper, 'The Generation of O(S-1) from the Dissociative Recombination of O2(+)', describes in detail the Multichannel Quantum Defect (MQDT) theory used for the calculation of dissociative recombination (DR) cross sections and rates. The application to the generation of the upper state of the atomic oxygen green line emission is of great importance to the modelling of planetary atmospheres. The second paper in the Appendix, 'Dissociative Recombination of the Ground State of N2(+)', applies the methods described in the first paper to N2(+). We find remarkable agreement with the prior microwave afterglow experiments for both the total recombination rate and for its electron temperature dependence. However, the results disagree with recent merged beams results which gave cross sections that are a factor of five below the microwave afterglow experiments and the current results. DR of N2(+) is an important mechanism for generating energetic N atoms which can escape the atmosphere of Mars. Currently we are

also continuing additional work on the DR of O2(+) which is aimed at calculating both the total DR rate as a function of ion vibrational level and the rate for production of O(D-1). I.I.C.

N93-19961*# Oregon State Univ., Corvallis.
WAVES AND INSTABILITY IN THE ATMOSPHERE OF MARS: NASA PLANETARY ATMOSPHERES PROGRAM Final Report, 1 Jul. 1987 - 31 Dec. 1990
Jeffrey R. Barnes 31 Dec. 1990 8 p
(Grant NAGw-1127)
(NASA-CR-192381; NAS 1.26:192381) Avail: CASI HC A02/MF A01

A broad range of phenomena were addressed by the study including the following: (1) polar warming; (2) forced stationary waves; (3) gravity waves; (4) transient baroclinic eddies; and (5) radiative-dynamical instabilities. A variety of numerical models have been employed in these studies, as well as analytical approaches. Some of the most significant results from this work are very briefly summarized. Author

N93-20732*# Arizona Univ., Tucson. Lunar and Planetary Lab.
INTERPRETATION OF VOYAGER UVS OBSERVATIONS OF OCCULTATIONS BY THE ATMOSPHERE OF NEPTUNE Annual Progress Report, period ending 31 Dec. 1991
Bill R. Sandel, F. Herbert, and R. V. Yelle Dec. 1991 10 p
(Grant NAGw-2441)
(NASA-CR-192131; NAS 1.26:192131) Avail: CASI HC A02/MF A01

We propose to continue our investigation of the upper atmosphere of Neptune based primarily on the solar occultation measurements made by the Voyager Ultraviolet Spectrometer (UVS). The ultimate goal of this research is to understand the structure and composition of Neptune's upper atmosphere as encoded in the data base obtained by the UVS during the Voyager 2 encounter with Neptune. The UVS occultations provide information essential to studies of atmospheric composition and structure, energy balance, photochemistry, global transport, ionospheric structure, and airglow production mechanisms. In conjunction with other research in progress at the University of Arizona and by our colleagues at other institutions, we not only analyze and interpret individual measurements or observations by the UVS, but also construct models of the upper atmosphere which are consistent with all available data obtained by the UVS. We derive constraints from measurements of the atmospheric emissions and we combine these with constraints derived from the occultation measurements. Principal sources for the atmospheric emissions include dayglow, resonance scattering and, at long wavelengths, the reflected solar spectrum. On the dark side of the planet, a weak H Ly alpha emission is due to resonance scattering of the sky background and perhaps another source. Thus a wide range of physical processes are at work, and each provides its own constraints on the atmosphere. Derived from text

N93-21013# European Space Agency, Paris (France). Lunar Study Steering Group.
MISSION TO THE MOON: EUROPE'S PRIORITIES FOR THE SCIENTIFIC EXPLORATION AND UTILISATION OF THE MOON
Bruce Battrick, ed. and C. Barron, ed. Jun. 1992 205 p Original contains color illustrations
(ESA-SP-1150; ISBN-92-9092-037-8; ETN-93-93499) Copyright Avail: CASI HC A10/MF A03

A study to determine Europe's potential role in the future exploration and utilization of the Moon is presented. To establish the scientific justifications the Lunar Study Steering Group (LSSG) was established reflecting all scientific disciplines benefitting from a lunar base (Moon studies, astronomy, fusion, life sciences, etc.). Scientific issues were divided into three main areas: science of the Moon, including all investigations concerning the Moon as a planetary body; science from the Moon, using the Moon as a platform and therefore including observatories in the broadest sense; science on the Moon, including not only questions relating to human activities in space, but also the development of artificial ecosystems beyond the Earth. Science of the Moon focuses on geographical, geochemical and geological observations of the Earth-Moon system. Science from the Moon takes advantage of the stable lunar ground, its atmosphere free sky and, on the far side, its radio quiet environment. The Moon provides an attractive platform for the observation and study of the Universe. Two techniques that can make unique cause of the lunar platform are ultraviolet to submillimeter interferometric imaging, and very low frequency astronomy. One of the goals of life sciences studies (Science on the Moon) is obviously to provide the prerequisite information for establishing a manned lunar base. This includes studies of human physiology under reduced gravity, radiation protection and life support systems, and feasibility studies based on existing hardware. The overall recommendations are essentially to set up specific study teams for those fields judged to be the most promising for Europe, with the aim of providing more detailed scientific and technological specifications. It is also suggested that the scope of the overall study activities be expanded in order to derive mission scenarios for a viable ESA lunar exploration program and to consider economic, legal and policy matters. The need for international coordination early in the study phase is emphasized. ESA

N93-21553*# Arizona Univ., Tucson. Space Engineering Research Center.
NASA SPACE ENGINEERING RESEARCH CENTER FOR UTILIZATION OF LOCAL PLANETARY RESOURCES Annual Executive Report, 1991-1992
1992 19 p LIMITED REPRODUCIBILITY: More than 20 percent of this document may be affected by color photographs
(Grant NAGw-1332)
(NASA-CR-191991; NAS 1.26:191991) Avail: CASI HC A03/MF A01; 16 functional color pages

In 1987, responding to widespread concern about America's competitiveness and future in the development of space technology and the academic preparation of our next generation of space professionals, NASA initiated a program to establish Space Engineering Research Centers (SERC's) at universities with strong doctoral programs in engineering. The goal was to create a national infrastructure for space exploration and development, and sites for the Centers would be selected on the basis of originality of proposed research, the potential for near-term utilization of technologies developed, and the impact these technologies could have on the U.S. space program. The Centers would also be charged with a major academic mission: the recruitment of topnotch students and their training as space professionals. This document describes the goals, accomplishments, and benefits of the research activities of the University of Arizona/NASA SERC. This SERC has become recognized as the premier center in the area known as In-Situ Resource Utilization or Indigenous Space Materials Utilization. Derived from text

N93-21642*# Colorado Univ., Boulder. Lab. for Atmospheric and Space Physics.
PLANETARY ATMOSPHERES: MICROWAVE SPECTROSCOPIC STUDIES OF PLANETARY ATMOSPHERES Final Report
R. Todd Clancy [1991] 15 p
(Grant NAGw-1228)
(NASA-CR-192145; NAS 1.26:192145) Avail: CASI HC A03/MF A01

Ground-based spectroscopic observations of isotopes of CO in the atmospheres of Mars, Venus, and Titan have been collected over the 1982-1990 period. These observations have been analyzed to obtain information on the photochemistry, dynamics, and thermal profiles of these planetary atmospheres. In the cases of the mesosphere (80-100 km altitude) of Venus and the lower atmosphere (0-70 km altitude) of Mars, the primary conclusion of this research is that significant interannual variations in the global thermal and compositional structures of these atmospheres occur over 10 year periods. The Titan studies have focussed on pinning down the true atmospheric CO abundance. A more detailed summary of the results for each of these planetary atmospheres is provided.
Derived from text

N93-21643*# California Inst. of Tech., Pasadena. Physics Lab.
PLANETARY ASTRONOMY RESEARCH Final Technical Report
26 Jun. 1991 9 p Original contains color illustrations
(Grant NAGw-1710)
(NASA-CR-192134; NAS 1.26:192134) Avail: CASI HC A02/MF A01; 2 functional color pages

The final technical report for the research in planetary astronomy is presented. Topics covered include: (1) ring systems in the outer solar system; (2) Pluto - Charon mutual occultations; (3) instrumentation; (4) planetary imaging with the Palomer Cassegrain near infrared camera; and (5) solar system survey. Derived from text

N93-21663*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
LUNAR SOILS GRAIN SIZE CATALOG
John C. Graf Mar. 1993 484 p
(NASA-RP-1265; S-642; NAS 1.61:1265) Avail: CASI HC A21/MF A04

This catalog compiles every available grain size distribution for Apollo surface soils, trench samples, cores, and Luna 24 soils. Original laboratory data are tabled, and cumulative weight distribution curves and histograms are plotted. Standard statistical parameters are calculated using the method of moments. Photos and location comments describe the sample environment and geological setting. This catalog can help researchers describe the geotechnical conditions and site variability of the lunar surface essential to the design of a lunar base. Author

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots. For related information see *93 Space Radiation.*

N93-20045*# Nebraska Univ., Lincoln. Dept. of Agricultural Meteorology.
CALIBRATION OF FIELD REFERENCE PANEL AND RADIOMETERS USED IN FIFE 1989 Semiannual Report, 1 Feb. - 30 Sep. 1990
Blaine L. Blad, Elizabeth A. Walter-Shea, Cynthia J. Hays, and Mark A. Mesarch Oct. 1990 15 p
(Grant NAG5-894)
(NASA-CR-192198; NAS 1.26:192198; AgMet-90-3) Avail: CASI HC A03/MF A01

Remote sensing of the earth's surface features involves the measurement of reflected solar radiation and the interpretation of the data in biophysical terms. Reflected radiation is a function of the surface properties and incident solar irradiance. The amount of radiation reflected from a surface is compared to the amount of solar radiation received at the surface as a means of comparing information from different times of day as well as for different days of the year. Thus, it is imperative to calibrate the instruments used to measure the incoming and reflected radiation. Author

N93-20266# National Inst. for Fusion Science, Nagoya (Japan).
X RAY SPECTRA FROM HINOTORI SATELLITE AND SUPRATHERMAL ELECTRONS
Takako Kato and Kuniaki Masai Oct. 1992 31 p Submitted for publication
(NIFS-197; AD-B169725L) Avail: CASI HC A03/MF A01

The X-ray spectra of H-like and He-like iron ions from a solar flare observed by Hinotori satellite, taking into account a possible contribution of high energy electrons is analyzed. The time behavior of the relative densities of iron ions was calculated for a plasma of non-equilibrium ionization in the presence of suprathermal electrons of a few percent fraction. This model can reproduce the time evolution of the H-like and He-like spectra consistently. Author (revised)

N93-20291 Stanford Univ., CA.
THE DETECTION AND CHARACTERIZATION OF HIGH FREQUENCY AND HIGH-WAVENUMBER SOLAR OSCILLATIONS Ph.D. Thesis
David Neil Fernandes 1992 130 p
Avail: Univ. Microfilms Order No. DA9234094

Doppler shift measurements of the Na D(sub 1) absorption line have revealed solar oscillations in a new regime of frequency and wavenumber. Oscillations of vertical velocities in the temperature minimum and low chromosphere of the Sun are observed with frequencies ranging up to 9.5 mHz. There is no evidence for chromospheric modes of 3 minute period. This indicates that the chromosphere does not form a good cavity for acoustic waves. The fundamental-modes appear with wavenumbers up to 5.57 Mm(exp -1) (equivalent spherical harmonic degree, 3877). The frequencies lie below the predicted values at wavenumbers above 1 Mm(exp -1). The values are in agreement with previous measurements that exist for wavenumbers up to 2.67 Mm(exp -1). Spatial maps of velocity power show that high wavenumber oscillations are suppressed in active regions. The shape of the power depression indicates that wave motion is affected in the layer of atmosphere where the measurement is made. The f-modes are suppressed in the same way as p-modes, indicating that the mechanism for wave suppression affects velocity fluctuations. Mode frequencies are not affected by the magnetic fields by more than 50 micro-Hz, the precision of the measurement. Dissert. Abstr.

N93-20571*# California Inst. of Tech., Pasadena.
MICROWAVE SPECTROSCOPY OF THE ACTIVE SUN Final Technical Report, 1 Oct. 1988 - 30 Nov. 1991
Gordon Hurford 13 Mar. 1992 6 p
(Grant NAGw-1706)
(NASA-CR-192135; NAS 1.26:192135) Avail: CASI HC A02/MF A01

In studies of solar active regions and bursts, the ability to obtain spatially resolved radio spectra (brightness temperature spectra) opens a whole new range of possibilities for study of the solar corona. For active regions, two-dimensional maps of brightness temperature over a wide range of frequencies allows one to determine temperature, column density, and magnetic field strength over the entire region in a straightforward, unambiguous way. For flares, the time-dependent electron energy distribution, number of accelerated electrons, and magnetic field strength and direction can be found. In practice, obtaining complete radio images at a large number of frequencies is a significant technical challenge, especially while keeping costs down. Our instrument at Owens Valley Radio Observatory provided the starting point for a modest attempt at meeting this goal. We proposed to build three additional, very low-cost 2-m antennas which, when combined with our existing two 27-m dishes, expands the array to 5 elements. This modest increase in number of solar dedicated antennas, from 2 to 5, increases our maximum number of physical baselines from 1 to 10 and allows the instrument to do true imaging of solar microwave sources, both bursts and active regions. Combined with the technique of frequency synthesis, the new array has up to 450 effective baselines, giving imaging capability that approaches that of a sub-arrayed VLA. The prototype antenna design was finalized and the antenna was put into operation in Nov. 1989. Author (revised)

N93-20754*# Rochester Univ., NY. Dept. of Mechanical Engineering.
SUNSPOT DYNAMICS Final Technical Report, 1 Apr. 1990 - 31 Mar. 1993
John H. Thomas 23 Feb. 1993 19 p
(Grant NAGw-2123)
(NASA-CR-192284; NAS 1.26:192284) Avail: CASI HC A03/MF A01

This report describes recent results of our theoretical and observational work on dynamical phenomena in sunspots. The overall goal of this research has been a better understanding of the various oscillatory, transient, and steady motions in a sunspot and their relation to the basic structure of the sunspot. The principal topics of the research reported here are the following: (1) sunspot seismology, i.e., the study of the interaction of solar p-modes with a sunspot as a probe of the subsurface structure of a sunspot; (2) local sources of acoustic waves in the solar photosphere; and (3) siphon flows in isolated magnetic flux tubes and their relation to the photospheric Evershed flow and to intense magnetic elements outside of sunspots. Author (revised)

N93-21212# National Geophysical Data Center, Boulder, CO.
SOLAR-GEOPHYSICAL DATA NUMBER 576, AUGUST 1992. PART 1: (PROMPT REPORTS). DATA FOR JULY, JUNE 1992 AND LATE DATA
Helen E. Coffey, ed. Aug. 1992 135 p
(PB93-112530; SGD-576-Pt-1) Avail: CASI HC A07/MF A02

The topics covered include the following: Detailed index for 1991-1992; Data for July 1992--Solar-terrestrial environment, IUWDS alert periods (Advance and Worldwide), Solar activity indices, Solar flares, Solar radio emission, and Stanford mean solar magnetic field; Data for June 1992--Solar active regions, Sudden ionospheric disturbances, Solar radio spectral observations, Cosmic ray measurements by neutron monitor, and Geomagnetic indices; Late data--Cosmic rays Climax May 1992; and Huancayo Apr.-May 1992, Geomagnetic indices May 1992, Sudden commencements Apr.-May 1992, and Errata--Geomagnetic aa indices Oct. 1991. GRA

N93-21213# National Geophysical Data Center, Boulder, CO.
SOLAR-GEOPHYSICAL DATA NUMBER 576, AUGUST 1992. PART 2: (COMPREHENSIVE REPORTS). DATA FOR FEBRUARY 1992 AND MISCELLANEOUS

Helen E. Coffey, ed. Aug. 1992 86 p
(PB93-112548; SGD-576-Pt-2) Avail: CASI HC A05/MF A01

The topics covered include the following: Detailed index for 1991-1992; and Data for February 1992--Solar flares, Solar radio bursts at fixed frequencies, Solar x-ray radiation from GOES satellite, Mass ejections from the sun, Interplanetary solar particles and plasma, and Active prominences and filaments. GRA

N93-21292# National Oceanic and Atmospheric Administration, Boulder, CO. Space Environment Lab.

PROCEEDINGS OF THE WORKSHOP ON THE SOLAR ELECTROMAGNETIC RADIATION STUDY FOR SOLAR CYCLE 22

Richard F. Donnelly, ed. Jul. 1992 483 p Workshop held in Boulder, CO, 3-7 Jun. 1991 Sponsored in part by Colorado Univ.; NSF; and International Council of Scientific Unions
(PB93-121846) Avail: CASI HC A21/MF A04

The Solar Electromagnetic Radiation Study for Solar Cycle 22 (SOLERS22) is an international program for collaborative research of long-term changes in the solar total and spectral irradiance. SOLERS22 is project 1.2 of STEP Working Group 1, The Sun as a Source of Energy and Disturbance. Temporal variations (0.1 percent) in the total solar irradiance (S) are important because of their possible effects on climate. Changes in the solar ultraviolet (UV) flux (10 percent) modulate the ozone density and temperature in the stratosphere and mesosphere. Large-percentage fluctuations (100 percent) in the solar extreme-ultraviolet flux induce sizable changes in the ionosphere and thermosphere. Huge enhancements (X10, X100) in solar soft x-ray flux cause enhancements in ionization and heating in the ionospheric D and E regions. It is, therefore, important to know what these solar electromagnetic fluxes are, as a function of time, to determine the main solar energy inputs to the terrestrial atmosphere. The Workshop had 5 major topics (Parts): Total Solar Irradiance and Near-UV, Visible and Infrared Spectral Irradiance; Solar Activity and Proxy Measurements; Solar UV Spectral Irradiance; Solar EUV Spectral Irradiance; Solar X-Ray Spectral Irradiance. GRA

N93-21346# National Geophysical Data Center, Boulder, CO.

SOLAR-GEOPHYSICAL DATA NUMBER 574, JUNE 1992. PART 2: (COMPREHENSIVE REPORTS). DATA FOR DECEMBER 1991 AND MISCELLANEOUS

Helen E. Coffey, ed. Jun. 1992 109 p
(PB92-218767; SGD-574-Pt-2; LC-79-640375) Avail: CASI HC A06/MF A02

The following contents are presented: detailed index for 1991-1992; data for december 1991--solar flares, solar radio bursts at fixed frequencies, solar x-ray radiation from GOES satellite, mass ejections from the sun, interplanetary solar particles and plasma, and active prominences and filaments. GRA

N93-21375# National Geophysical Data Center, Boulder, CO.

SOLAR-GEOPHYSICAL DATA NUMBER 573, MAY 1992. PART 1: PROMPT REPORTS, DATA FOR APRIL, MARCH 1992 AND LATE DATA

Helen E. Coffey, ed. May 1992 137 p
(PB92-213461; SGD-573-Pt-1; LC-79-640375) Avail: CASI HC A07/MF A02

The topics covered include the following: detailed index for 1991-1992; data for April 1992 -- solar-terrestrial environment, solar activity indices, solar flares, solar radio emission, Stanford mean solar magnetic field; data for March 1992 -- solar active regions, sudden ionospheric disturbances, solar radio spectral observations, cosmic ray measurements by neutron monitor, geomagnetic indices; and late data -- cosmic rays Huancayo Jan.-Feb. 1992, sudden commencements Sep.-Nov. 1991, Provisional Dst Dec. 1991. GRA

N93-21376# National Geophysical Data Center, Boulder, CO.

SOLAR-GEOPHYSICAL DATA NUMBER 573, MAY 1992. PART 2: COMPREHENSIVE REPORTS, DATA FOR NOVEMBER 1991 AND MISCELLANEOUS

Helen E. Coffey, ed. May 1992 82 p
(PB92-213479; SGD-573-Pt-2; LC-79-640375) Avail: CASI HC A05/MF A01

The topics covered include the following: Detailed index for 1991-1992; Data for November 1991 -- Solar flares, Solar radio bursts at fixed frequencies, Solar x-ray radiation from GOES satellite, Mass ejections from the sun, Interplanetary solar particles and plasma, Active prominences and filaments; and Miscellaneous data -- IMP-8 Solar wind May-Oct. 1991. GRA

N93-21385# National Geophysical Data Center, Boulder, CO.

SOLAR-GEOPHYSICAL DATA NUMBER 577, SEPTEMBER 1992. PART 1: PROMPT REPORTS, DATA FOR AUGUST, JULY 1992 AND LATE DATA

Helen E. Coffey, ed. Sep. 1992 133 p
(PB93-116945; SGD-575-Pt-1; LC-79-640375) Avail: CASI HC A07/MF A02

The contents are as follows: Detailed index for 1992; Data for August 1992 -- Solar-terrestrial environment, IUWDS alert periods (Advance and Worldwide), Solar activity indices, Solar flares, Stanford mean solar magnetic field; Data for July 1992 -- Solar active regions, Sudden ionospheric disturbances, Solar radio spectral observations, Cosmic ray measurements by neutron monitor, Geomagnetic indices; and Late data -- Sudden Commencements Jun. 1992. GRA

N93-21386# National Geophysical Data Center, Boulder, CO.

SOLAR-GEOPHYSICAL DATA NUMBER 577, SEPTEMBER 1992. PART 2: COMPREHENSIVE REPORTS, DATA FOR MARCH 1992 AND MISCELLANEOUS

Helen E. Coffey, ed. Sep. 1992 77 p
(PB93-116952; SGD-577-Pt-2; LC-79-640375) Avail: CASI HC A05/MF A01

The contents are as follows: Detailed index for 1992; Data for March 1992 -- Solar flares, Solar radio bursts at fixed frequencies, Solar x-ray radiation from GOES satellite, Mass ejections from the sun, Active prominences and filaments, Solar irradiance; and Miscellaneous data -- NIMBUS solar irradiance data Nov. 1978-Jun. 1992, and NOAA SESC solar proton events Jan. 1976-Aug. 1992. GRA

N93-21469# National Geophysical Data Center, Boulder, CO.

SOLAR-GEOPHYSICAL DATA NUMBER 575, JULY 1992. PART 1: (PROMPT REPORTS). DATA FOR MAY, APRIL 1992 AND LATE DATA

Helen E. Coffey Jul. 1992 130 p
(PB92-235993; SGD-575-Pt-1) Avail: CASI HC A07/MF A02

Detailed index for 1991-1992; Data for June 1992 -- Solar-terrestrial environment, IUWDS alert periods (Advance and worldwide), Solar activity indices, Solar flares, Solar radio emission, Stanford mean solar magnetic field; Data for May 1992 -- Solar active regions, Sudden ionospheric disturbances, Solar radio spectral observations, Cosmic ray measurements by neutron monitor, Geomagnetic indices; and Late data -- Cosmic rays Kiel Apr. 1992, Sudden commencements Dec. 91-Mar. 92. GRA

N93-21470# National Geophysical Data Center, Boulder, CO.

SOLAR-GEOPHYSICAL DATA NUMBER 575, JULY 1992. PART 2: (COMPREHENSIVE REPORTS). DATA FOR JANUARY 1992 AND MISCELLANEOUS

Helen E. Coffey Jul. 1992 70 p
(PB92-236009; SGD-575-Pt-2) Avail: CASI HC A04/MF A01

Contents: Detailed index for 1991-1992; Data for January 1992 -- Solar flares, Solar radio bursts at fixed frequencies, Solar x-ray radiation from GOES satellite, Mass ejections from the sun, Interplanetary solar particles and plasma IMP-8 solar wind, and Active prominences and filaments. GRA

N93-21786# Helsinki Univ. of Technology, Kylmaelae (Finland). Metsaehovi Radio Research Station.

SOLAR RADIO FLARES 1989-1991. SOLAR MICROWAVE FLARES OBSERVED AT METSAEHOVI RADIO RESEARCH STATION IN 1989-1991

Seppo Urpo, Silja Pohjolainen, and Harri Teraesranta 1992 125 p
(PB93-111896; ISBN-951-22-1183-1; SER-A-11) Avail: CASI HC A06/MF A02

The Metsaehovi Radio Research Station, a separate research institute of the Helsinki University of Technology since May 1988, operates a 14 m diameter radio telescope at Metsaehovi, Kylmala. Annually the telescope has been reserved for solar measurements for 4-10 weeks, typically during

the summer months. Measurements include maps of the whole or part of the Sun, tracking of active regions and solar oscillation monitoring. Most of the solar observations have been done using receivers operating at 22.2 GHz or at 36.8 GHz. The sensitivity of receivers is good enough for 0.1 sfu resolution. In the temperature scale the resolution is better than 100 K and it is limited by short term changes in the atmospheric attenuation. Solar maps are measured by scanning the solar disk in right ascension and by changing the declination in small steps between the subsequent scans. The volume contains a list of radio flares observed at Metsaehovi Radio Research Station in 1989-1991 and a selection of time profiles of the bursts. GRA

N93-21962# Brookhaven National Lab., Upton, NY.
THE GALLEX SOLAR NEUTRINO EXPERIMENT
R. L. Hahn 1992 4 p Presented at the Meeting of the Division of Particles and Fields of the American Physics Society, Batavia, IL, 10-14 Nov. 1992
(Contract DE-AC02-76CH-00016)
(DE93-003357; BNL-48171; CONF-921122-5) Avail: CASI HC A01/MF A01

The recently published GALLEX result, 83 +/- 19 (stat.) +/- 8 (syst.) SNU (1(sigma)), was obtained from data accumulated from 14 solar runs (with counting done to May 1992). This value, while 2 standard deviations below the predictions of solar models, provided the first direct evidence for solar pp neutrinos. The signature for neutrino capture in the aqueous gallium-chloride detector was the observation of the characteristic energy spectrum (K and L X-rays/Auger electrons), decaying with the half-life of the chemically isolated radioactive product, Ge-71. By adding to the data set 1 more solar run plus 4 additional months of counting (to Sep. 1992), an updated value of the GALLEX production rate was obtained, which, interestingly, does not differ perceptibly from our published value. DOE

N93-21967# Los Alamos National Lab., NM.
THEORY OF CORONAL STREAMER FORMATION
R. A. Kopp 1992 9 p Presented at the Solar and Heliospheric Observatory Workshop, Annapolis, MD, 25-28 Aug. 1992
(Contract W-7405-eng-36)
(DE93-003736; LA-UR-92-3336; CONF-9208187-1) Avail: CASI HC A02/MF A01

Conceptually, coronal streamers can form (and disappear) by either of two distinct processes: (1) plasma 'filling' and outward distention of a preexisting closed magnetic structure; and (2) magnetic reconnection, for whatever reason, of an open bipolar field configuration. We argue that the majority of stable-appearing streamers on the Sun at any time are in fact of the latter category - namely, open-field structures undergoing gradual reconnection. Quasi-steady (i.e., 'convectively relaxed') reconnection models may be required to explain the narrow high-density cores exhibited by most streamers out to distances of many solar radii. Some of the observational signatures of reconnection within streamers, which the instrumentation aboard SOHO may be capable of detecting are discussed. DOE

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N93-20601*# Polish Academy of Sciences, Warsaw. Astronomical Center.
CAN THE COSMIC X RAY AND GAMMA RAY BACKGROUND BE DUE TO REFLECTION OF A STEEP POWER LAW SPECTRUM AND COMPTON SCATTERING BY RELATIVISTIC ELECTRONS?
Piotr T. Zycki, Andrzej A. Zdziarski, and Roland Svensson (Stockholm Observatory, Sweden.) 1991 9 p Sponsored in part by NATO and the Polish State Committee for Scientific Research
(Grant NAG5-1570)
(NASA-CR-192255; NAS 1.26:192255) Avail: CASI HC A02/MF A01

We reconsider the recent model for the origin in the cosmic X-ray and gamma-ray background by Rogers and Field. The background in the model is due to an unresolved population of AGNs. An individual AGN spectrum contains three components: a power law with the energy index of alpha = 1.1, an enhanced reflection component, and a component from Compton scattering by relativistic electrons with a low energy cutoff at some minimum Lorentz factor, gamma(sub min) much greater than 1. The MeV bump seen in the gamma-ray background is then explained by inverse Compton emission by the electrons. We show that the model does not reproduce the shape of the observed X-ray and gamma-ray background below 10 MeV and that it overproduces the background at larger energies. Furthermore, we find the assumptions made for the Compton component to be physically inconsistent. Relaxing the inconsistent assumptions leads to model spectra even more different from that of the observed cosmic background. Thus, we can reject the hypothesis that the high-energy cosmic background is due to the described model. Author

N93-20747*# California Inst. of Tech., Pasadena. Physics Lab.
TIMING ANALYSIS OF LOW-ENERGY GAMMA RAY EMISSION FROM GALACTIC COMPACT OBJECTS USING THE GAMMA RAY OBSERVATORY Annual Status Report, 1 Oct. 1990 - 31 Dec. 1991
Thomas A. Prince 3 Apr. 1992 11 p Original contains color illustrations
(Grant NAG5-1458)
(NASA-CR-192253; NAS 1.26:192253) Avail: CASI HC A03/MF A01; 1 functional color page

The principal goal of our phase 1 investigation was the development of techniques and data analysis tools for pulsar searches and timing. After the launch of the Compton Observatory, we received from the Burst and Transient Source Experiment (BATSE) team one day of discriminator large area (DISCLA) data for use in the development and testing of data analysis techniques. Using this first day of data for testing and optimizing our timing tools we detected four x-ray binary pulsars, Vela X-1, Cen X-3, 4U 0115+63, and GX 301-2. Subsequently, we received four more days of data, allowing us to test our timing tools with data from a variety of days. In summary, using the tools we developed based on the first day of data that we received, we have detected 8 pulsars in 5 days of data, or roughly one quarter of the approximately 30 known x-ray binary pulsars. In addition to the pulsars listed above, we detected GX 1+4, 4U 1626-67, OAO 1657-415, and Her X-1. Many of the data analysis tools that we developed have been ported to MSFC and are being used for the analysis of BATSE data. This appendix describes some of the timing tools and presents preliminary pulse period and phase profile results.
Derived from text

N93-21053# Astronomische Rechen-Inst., Heidelberg (Germany).
ANALYSIS AND SYNTHESIS OF CATALOGUES OF EXTRAGALACTIC RADIO SOURCES
H. G. Walter 1990 5 p Repr. from Reference Systems. Proceedings of the 127th Colloquium of the IAU (Naval Observatory), 1991 p 376-380
(Mitt-Ser-A-231; ETN-93-93408) Avail: CASI HC A01/MF A01

Recent observation catalogs of extragalactic radio sources obtained by Very Long Baseline Interferometry (VLBI) agree in the mean to a few milliarcseconds (mas). Within this range the position differences show constant, linear, and periodic offsets. To cast light on these offsets the differences between some of the representative observation catalogs are plotted. Especially, the periodic variations of declination differences of observation catalogs having significantly different epochs are tentatively explained by an uncertainty of the general precession in declination. In terms of luni-solar precession this uncertainty is estimated to be of the order of -1 to -2 mas per year. ESA

99 GENERAL

N93-19975*# Hernandez Engineering, Inc., Houston, TX.
THIRTY YEARS TOGETHER: A CHRONOLOGY OF U.S.-SOVIET SPACE COOPERATION
David S. F. Portree Feb. 1993 51 p
(NASA-CR-185707; NAS 1.26:185707) Avail: CASI HC A04/MF A01

The chronology covers 30 years of cooperation between the U.S. and the Soviet Union (and its successor, the Commonwealth of Independent

States, of which the Russian Federation is the leading space power). It tracks successful cooperative projects and failed attempts at space cooperation. Included are the Dryden-Blagonravov talks; the UN Space Treaties; the Apollo Soyuz Test Project; COSPAS-SARSAT; the abortive Shuttle-Salyut discussions; widespread calls for joint manned and unmanned exploration of Mars; conjectural plans to use Energia and other Russian space hardware in ambitious future joint missions; and contemporary plans involving the U.S. Shuttle, Russian Mir, and Soyuz-TM. The chronology also includes events not directly related to space cooperation to provide context. A bibliography lists works and individuals consulted in compiling the chronology, plus works not used but relevant to the topic of space cooperation. Author

N93-20857# Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H., Vienna.

[ACTIVITIES OF THE SEIBERSDORF RESEARCH CENTER] Annual Report, 1991 [JAHRESBERICHT 1991, FORSCHUNGSZENTRUM SEIBERSDORF]

Harald Thurnher 1992 39 p In GERMAN

(ETN-93-92597) Avail: CASI HC A03/MF A01

The organization structure of the research center was fundamentally modified and adapted to the requirements of the future. Important research and development projects were carried out with international partners. Interdisciplinary solutions were found in the fields of measurement technology and information processing with regard to production rationalization and insurance quality. Special miniaturized liquid metal ion sources were developed for use in international space missions for the stabilization of the electric potential of research satellites. Instruments for in situ material analyses were developed in space stations with regard to corrosion. Work was carried out in the field of drinking water and sewage purification. High duty components were developed for the homogeneity of phosphorus doping of the monocrystals of pure silicon. Projects were developed in the field of environment and forest protection, and research was conducted with international partners on the project 'steels for high temperature steam turbines'. ESA

N93-21022# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany). Abt. Operative Unternehmensplanung.

SUMMARIES OF THE 1991 PUBLICATIONS OF DLR RESEARCH REPORTS AND DLR COMMUNICATIONS [JAHRESVERZEICHNIS 1991. DLR-FORSCHUNGSBERICHT UND DLR-MITTEILUNGEN]

W. Wilke Mar. 1992 34 p In GERMAN

(ETN-93-92588) Avail: CASI HC A03/MF A01

Abstracts for DLR research reports are presented. Research topics analyzed included the following: flight mechanics, inflight operational procedure, flight medicine, traffic research, theoretical and experimental flow mechanics, design aerodynamics, drive technique, structural mechanics, design aerodynamics, aeroelasticity, material research, space simulation, high frequency technique, and atmospheric physics. ESA

N93-21349# Department of Defense, Washington, DC. Director of Defense Research and Engineering.

DEFENSE SCIENCE AND TECHNOLOGY STRATEGY: EXECUTIVE SUMMARY. 1: BACKGROUND AND OVERVIEW. 2: THE SEVEN THRUSTS

Jul. 1992 112 p

(PB92-217785) Avail: CASI HC A06/MF A02

The document presents the strategic plan for the Defense Department's Science and Technology program. It forms the basis for decisions and actions and provides the foundations for long- and short-range planning. Section 1 explains how changes in the world security environment have affected the requirements placed on the S&T program through changes in U.S. force structure and military and operational strategies. In particular, it explains how the S&T program is affected by the following: (1) improvements in the information and communications flow between the S&T and 'user' (warfighting) communities; (2) the revolution in information technology; and (3) the increased role of Advanced Technology Demonstrations (ATD's). GRA

N93-21381# Army Research Inst. for the Behavioral and Social Sciences, Alexandria, VA.

LIST OF US ARMY RESEARCH INSTITUTE RESEARCH AND TECHNICAL PUBLICATIONS, OCTOBER 1, 1990 TO SEPTEMBER 30, 1991 WITH AUTHOR AND SUBJECT INDEX

Mar. 1992 87 p

(PB93-108611) Avail: CASI HC A05/MF A01

The primary responsibility of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) is to maximize soldier effectiveness. ARI accomplishes its mission through research and development in the acquisition, training, utilization, and retention of Army personnel. As convenient references for qualified agencies and individuals and sponsors, ARI publishes lists of its technical and research publications. The issue of the publication list describes reports published during the period 1 Oct. 1990 to 30 Sep. 1991. It contains the abstract of each publication and the bibliographic information needed to identify a publication. Author and subject indexing provides access to individual reports and topics. GRA

N93-21554*# Arizona Univ., Tucson. Space Engineering Research Center.

NASA SPACE ENGINEERING RESEARCH CENTER FOR UTILIZATION OF LOCAL PLANETARY RESOURCES Annual Executive Report, 1989-1990

1990 25 p Original contains color illustrations

(Grant NAGw-1332)

(NASA-CR-191992; NAS 1.26:191992) Avail: CASI HC A03/MF A01; 6 functional color pages

In 1987, responding to widespread concerns about both the health of American space technology development and the academic preparation of 21st-century space professionals, NASA announced a nationwide competition to establish a number of Space Engineering Research Centers. These centers were to be founded on the campuses of nine Universities with strong Doctoral programs in Engineering. Over 115 proposals were received by NASA in November 1987. The University of Arizona's proposal was selected in May as one of the winners, with a budget of approximately $7 million guaranteed by NASA for a minimum funding period of five years. The role of the University of Arizona SERC is to develop the technologies necessary to produce a wide variety of useful products using the materials and sources of energy that occur naturally in near-Earth space. An additional purpose is to lower the cost and extend the scope of large-scale activities. A brief description of the Center's activities for the 1989-1990 period is presented. Derived from text

N93-21660*# Massachusetts Inst. of Tech., Cambridge. Space Engineering Research Center.

MIT SPACE ENGINEERING RESEARCH CENTER TESTBED PROGRAMS Semiannual Report, period ending Jan. 1991

Edward F. Crawley and David W. Miller May 1991 340 p

(Grant NAGw-1335)

(NASA-CR-192115; NAS 1.26:192115; SERC-4-91-R) Avail: CASI HC A15/MF A03

The Space Engineering Research Center (SERC) at M.I.T., started in July 1988, has completed two and one-half years of research. This Semi-Annual Report presents annotated viewgraph material presented at the January 1991 Steering Committee and Technical Representative Review. The objective of the Space Engineering Research Center is to develop and disseminate a unified technology of controlled structures. There has been continued evolution of the concept of intelligent structures (including in this past year the first successful embedding of a microelectronic component into a structural element). Derived from text

N93-21764# European Space Agency, Paris (France).

[ACTIVITIES REPORT OF THE EUROPEAN SPACE AGENCY] Annual Report, 1991 [AGENCE SPATIALE EUROPEENNE, RAPPORT ANNUEL 1991]

T.-D. Guyenne, ed. and N. Longdon, ed. Aug. 1992 216 p In FRENCH Original contains color illustrations

(ETN-93-93509) Copyright Avail: CASI HC A10/MF A03

Development programs concerning the scientific missions, Earth and environment observation, telecommunications, space transportation system, space stations, microgravity research, and the European astronaut center are described. Basic activities in scientific research, research and

development technology, data processing and archiving, and technical infrastructure are described. Installations for information systems and ESANET, space systems, mission support, and satellite operations are described. The administration of ESA establishments, structure and organization, finance and contracts, and external relations is described. During 1991, five ESA scientific satellites operated in orbit: the long lifetime IUE; Giotto to its second cometary encounter; Hipparcos, which along with the Hubble Space Telescope, transmits astronomical data, and Ulysses, which gave solar system information on its way to Jupiter. Technical problems affecting the launch date were encountered with ISO (Infrared Space Observatory). The launch of ERS marked a step in global Earth observation, and the apparently lost Olympus satellite was recovered. The Eureca platform for microgravity experiments was prepared for takeoff. ESA

N93-21808# Office of Naval Research, Arlington, VA.
NAVAL RESEARCH REVIEWS, VOLUME 44, NO. 1, 1992
William J. Lescure, ed. 1992 61 p
(PB93-129682) Avail: CASI HC A04/MF A01; SOD HC

The contents are as follows: Tropical Cyclone Motion; Fiber-Optic Interferometer Push-Pull Hydrophones; Research in Ultra-Wideband Impulse Radar Target Identification; Research on Autonomous Underwater Vehicles at the Naval Postgraduate School; The NPS Research Program; CAPS--A Tool for Real-Time System Development and Acquisition; Determining Fatigue Crack Growth in Aircraft by Monitoring Acoustic Emission; and Liquid Immersion Cooling of Electronic Equipment. GRA

N93-21814# National Inst. of Standards and Technology, Gaithersburg, MD.
JOURNAL OF RESEARCH OF THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY, JULY-AUGUST 1992. VOLUME 97, NUMBER 4
Barry N. Taylor, ed. 1992 107 p
(PB93-124246) Avail: CASI HC A06/MF A02; SOD HC

The contents of this document are divided into the following two sections: (1) articles--new wavenumber calibration tables from heterodyne frequency measurements and symmetric level index arithmetic in simulation and modeling; and (2) conference reports--workshop on polymer blends and news briefs. GRA

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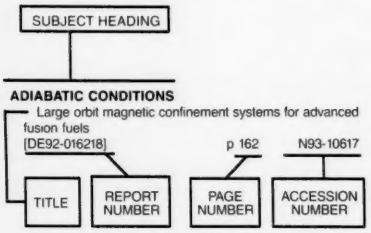

The subject heading is a key to the subject content of the document. Titles, report numbers, and accession numbers of pertinent documents are provided under each subject heading. When the title is insufficiently descriptive of the document content, a title extension has been added, separated from the title by three hyphens. The report number helps to indicate the type of document cited (e.g., NASA report, NASA translation, NASA contractor report). The accession number is the number by which the document abstracts are arranged in this journal and by which the document is sold or requested. The page number helps you locate the citation in the abstract section. The titles, with title extensions if present, are arranged under each subject heading in ascending accession number order. The subject headings have been selected from the latest revision of the *NASA Thesaurus*.

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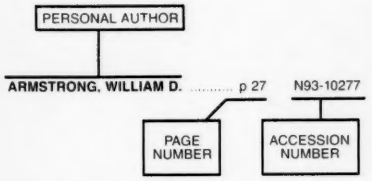

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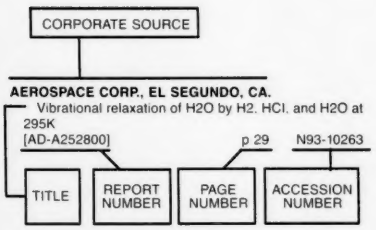

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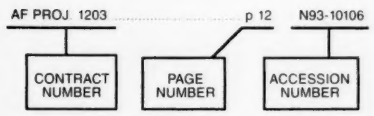

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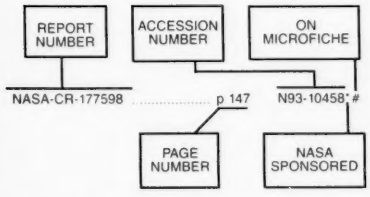

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DE93-002998 ..... p 2083 N93-21984 #
DE93-002999 ..... p 2082 N93-21757 #
DE93-003005 ..... p 1857 N93-21985 #
DE93-003051 ..... p 1857 N93-21986 #
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DE93-003165 ..... p 1857 N93-21958 #
DE93-003216 ..... p 2092 N93-21959 #
DE93-003249 ..... p 1886 N93-21960 #
DE93-003252 ..... p 1989 N93-21961 #
DE93-003357 ..... p 2102 N93-21962 #
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DE93-004243 ..... p 2045 N93-21741 #
DE93-004254 ..... p 1862 N93-21853 #
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DE93-004634 ..... p 1907 N93-21704 #
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DE93-004646 ..... p 1995 N93-21975 #
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DE93-005117 ..... p 2063 N93-21707 #
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DE93-005128 ..... p 1912 N93-21709 #
DE93-005132 ..... p 2081 N93-21710 #
DE93-005381 ..... p 1951 N93-21711 #
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DE93-005719 ..... p 1852 N93-21835 #
DE93-005926 ..... p 1861 N93-21731 #
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DLR-MITT-91-14 ..... p 2014 N93-21367 #
DLR-MITT-91-15 ..... p 2061 N93-21368 #
DLR-MITT-91-16 ..... p 1785 N93-21173 #
DLR-MITT-91-18 ..... p 1906 N93-21039 #
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DLR-MITT-91-20 ..... p 1860 N93-21041 #
DLR-MITT-91-21 ..... p 1779 N93-21004 #
DLR-MITT-92-04 ..... p 1910 N93-20745 #
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DODA-AR-007-108 ..... p 1788 N93-20555 #

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DOE/CE-27504/2 ..... p 1994 N93-21834 #

DOE/CS-62018/T1 ..... p 1916 N93-21667 #

DOE/EA-0621 ..... p 1952 N93-21839 #

DOE/EIA-0484(92) ..... p 1988 N93-21550 #

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DOE/ER-10713/T3 ..... p 2061 N93-20385 #
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DOE/ER-54139/1 ..... p 2075 N93-21483 #
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DOE/ER-75585/2 ..... p 1912 N93-21709 #
DOE/ER-75645/1 ..... p 1988 N93-21833 #
DOE/ER-81349/93/C0125 ..... p 1860 N93-21252 #

DOE/ET-53088-577 ..... p 2075 N93-21697 #
DOE/ET-53088-583 ..... p 2076 N93-21830 #
DOE/ET-53088/578 ..... p 2077 N93-21995 #

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DOE/ID-12850/6 ..... p 1988 N93-21665 #

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DOE/MC-25034/93/C0096 ..... p 1860 N93-21491 #
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E-7230 ..... p 1897 N93-19969 * #
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EGG-EP-10296 ..... p 1995 N93-21965 #

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ESA-PSS-04-107-ISSUE-2 ..... p 1884 N93-21001 #
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NASA-CR-192277 ..... p 1785 N93-21210 * #
NASA-CR-192280 ..... p 2002 N93-20038 * #
NASA-CR-192282 ..... p 1761 N93-20256 * #
NASA-CR-192284 ..... p 2100 N93-20754 * #
NASA-CR-192288 ..... p 1760 N93-20235 * #
NASA-CR-192289 ..... p 1821 N93-20234 * #
NASA-CR-192292 ..... p 2049 N93-21812 * #
NASA-CR-192293 ..... p 2089 N93-20315 * #
NASA-CR-192295 ..... p 2026 N93-20314 * #
NASA-CR-192296 ..... p 1901 N93-20753 * #
NASA-CR-192297 ..... p 1901 N93-20767 * #
NASA-CR-192302 ..... p 1881 N93-20233 * #
NASA-CR-192306 ..... p 1847 N93-20756 * #
NASA-CR-192307 ..... p 2077 N93-20037 * #
NASA-CR-192308 ..... p 2033 N93-20603 * #
NASA-CR-192309 ..... p 1901 N93-20748 * #
NASA-CR-192310 ..... p 1880 N93-19993 * #
NASA-CR-192316 ..... p 2002 N93-19987 * #
NASA-CR-192318 ..... p 1888 N93-20162 * #
NASA-CR-192319 ..... p 2078 N93-20236 * #
NASA-CR-192323 ..... p 2095 N93-20793 * #
NASA-CR-192336 ..... p 1829 N93-20896 * #
NASA-CR-192337 ..... p 2096 N93-20757 * #
NASA-CR-192341 ..... p 2071 N93-20362 * #
NASA-CR-192357 ..... p 2097 N93-21196 * #
NASA-CR-192358 ..... p 1998 N93-20758 * #
NASA-CR-192361 ..... p 2025 N93-20908 * #
NASA-CR-192363 ..... p 1880 N93-20043 * #
NASA-CR-192364 ..... p 1914 N93-20759 * #
NASA-CR-192365 ..... p 1878 N93-21815 * #
NASA-CR-192366 ..... p 2072 N93-20760 * #
NASA-CR-192368 ..... p 1884 N93-20613 * #
NASA-CR-192381 ..... p 2099 N93-19961 * #
NASA-CR-192382 ..... p 2023 N93-20736 * #
NASA-CR-192405 ..... p 2029 N93-19981 * #
NASA-CR-192407 ..... p 2094 N93-20746 * #
NASA-CR-192408 ..... p 2088 N93-20161 * #
NASA-CR-192409 ..... p 1997 N93-20302 * #
NASA-CR-192433 ..... p 1979 N93-21698 * #
NASA-CR-192470 ..... p 2027 N93-22002 * #
NASA-CR-192617 ..... p 1915 N93-20918 * #
NASA-CR-192618 ..... p 1945 N93-20915 * #
NASA-CR-192619 ..... p 1892 N93-20910 * #
NASA-CR-192620 ..... p 2074 N93-20914 * #
NASA-CR-192621 ..... p 1829 N93-20912 * #
NASA-CR-192654 ..... p 1903 N93-21662 * #
NASA-CR-192707 ..... p 2042 N93-22004 * #
NASA-CR-192710 ..... p 1783 N93-22003 * #
NASA-CR-192719 ..... p 1885 N93-21201 * #
NASA-CR-192720 ..... p 2014 N93-21492 * #
NASA-CR-192729 ..... p 1821 N93-21477 * #
NASA-CR-192732 ..... p 1893 N93-21309 * #
NASA-CR-192733 ..... p 2048 N93-21373 * #
NASA-CR-192734 ..... p 2048 N93-21308 * #
NASA-CR-192735 ..... p 2049 N93-21391 * #
NASA-CR-192737 ..... p 2049 N93-21390 * #
NASA-CR-192742 ..... p 2048 N93-21372 * #
NASA-CR-192743 ..... p 1947 N93-21307 * #
NASA-CR-192756 ..... p 2048 N93-21306 * #
NASA-CR-192780 ..... p 2048 N93-21371 * #
NASA-CR-4489 ..... p 2044 N93-21043 * #

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NASA-GP-23-1 ..... p 2024 N93-20998 * #

NASA-NP-136 ..... p 2086 N93-21128 * #

NASA-RP-1265 ..... p 2100 N93-21663 * #

NASA-SBIR-PC-90 ..... p 2087 N93-21794 * #

NASA-SP-7011(371) ..... p 2024 N93-20889 *
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NASA-TM-103944 ..... p 1897 N93-20035 * #
NASA-TM-103946 ..... p 1759 N93-20323 * #
NASA-TM-103947 ..... p 1783 N93-21810 * #
NASA-TM-103957 ..... p 1996 N93-20066 * #
NASA-TM-103992 ..... p 2027 N93-21807 * #
NASA-TM-104267 ..... p 1784 N93-20163 * #
NASA-TM-104572 ..... p 1999 N93-20900 * #
NASA-TM-104579 ..... p 2017 N93-20160 * #
NASA-TM-104758 ..... p 2022 N93-20303 * #
NASA-TM-104759 ..... p 1852 N93-22006 * #
NASA-TM-105185 ..... p 1822 N93-19988 * #
NASA-TM-105756 ..... p 1982 N93-20261 * #
NASA-TM-105800 ..... p 1897 N93-19969 * #
NASA-TM-105804 ..... p 1787 N93-21197 * #
NASA-TM-105824 ..... p 1925 N93-20368 * #
NASA-TM-105916 ..... p 1855 N93-19974 * #
NASA-TM-105924 ..... p 1759 N93-20902 * #
NASA-TM-105966 ..... p 1882 N93-20260 * #
NASA-TM-105985 ..... p 1898 N93-20057 * #
NASA-TM-105998 ..... p 1882 N93-20257 * #
NASA-TM-106007 ..... p 1784 N93-20109 * #
NASA-TM-106016 ..... p 1832 N93-20317 * #
NASA-TM-106027 ..... p 1920 N93-19971 * #
NASA-TM-106030 ..... p 1760 N93-19968 * #
NASA-TM-106037 ..... p 1889 N93-20259 * #
NASA-TM-106039 ..... p 1902 N93-21198 * #
NASA-TM-106053 ..... p 1829 N93-20614 * #
NASA-TM-106060 ..... p 1829 N93-20615 * #
NASA-TM-107599-REV-D ..... p 2028 N93-21027 *
NASA-TM-107698 ..... p 1759 N93-19976 * #
NASA-TM-107712 ..... p 1859 N93-20300 * #
NASA-TM-107727 ..... p 1760 N93-19973 * #
NASA-TM-107735 ..... p 1824 N93-20922 * #
NASA-TM-108023 ..... p 2026 N93-21370 * #
NASA-TM-108042 ..... p 2024 N93-21369 * #
NASA-TM-108145 ..... p 2087 N93-21794 * #
NASA-TM-108190 ..... p 1779 N93-21190 * #
NASA-TM-108203 ..... p 1824 N93-20999 * #
NASA-TM-108217 ..... p 1830 N93-21645 * #
NASA-TM-108392 ..... p 2091 N93-20920 * #
NASA-TM-108394 ..... p 1920 N93-19972 * #
NASA-TM-108582 ..... p 2024 N93-20998 * #
NASA-TM-108597 ..... p 1812 N93-21407 * #
NASA-TM-108607 ..... p 2018 N93-20891 * #
NASA-TM-108646 ..... p 1820 N93-19990 * #
NASA-TM-108650 ..... p 1904 N93-21819 * #
NASA-TM-108651 ..... p 2085 N93-20329 * #
NASA-TM-108654 ..... p 2085 N93-20774 * #
NASA-TM-108655 ..... p 2085 N93-20775 * #
NASA-TM-108679 ..... p 2088 N93-20111 * #
NASA-TM-108680 ..... p 2088 N93-20110 * #
NASA-TM-108702 ..... p 2086 N93-21188 * #
NASA-TM-4389 ..... p 1952 N93-21831 * #
NASA-TM-4407 ..... p 1908 N93-21816 * #
NASA-TM-4411 ..... p 1900 N93-20299 * #
NASA-TM-4445 ..... p 2034 N93-20778 * #
NASA-TM-4482 ..... p 1999 N93-21374 * #

NASA-TP-3225 ..... p 1925 N93-20585 * #
NASA-TP-3241 ..... p 1781 N93-20584 * #
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NASA-TP-3297 ..... p 2026 N93-20319 * #
NASA-TP-3298 ..... p 2022 N93-20318 * #

NASDA-CM-174 ..... p 1975 N93-21270 #

NASDA-EG-920021 ..... p 1875 N93-21950 #

NASDA-TK-GC0066 ..... p 1789 N93-20410 #

NATICK-TR-93/008 ..... p 1904 N93-21977 #

NATICK/TR-93/009 ..... p 2026 N93-21269 #

NAVY-CASE-70118 ..... p 1889 N93-20328 #
NAVY-CASE-70230 ..... p 2067 N93-20397 #
NAVY-CASE-71961 ..... p 1909 N93-20262 #
NAVY-CASE-72951 ..... p 1888 N93-20028 #
NAVY-CASE-72965 ..... p 1859 N93-20398 #
NAVY-CASE-73111 ..... p 1893 N93-21250 #
NAVY-CASE-73161 ..... p 1890 N93-20396 #
NAVY-CASE-73175 ..... p 2077 N93-20027 #
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NCAR/CT-136 ..... p 1993 N93-21790 #

NCAR/TN-373+STR ..... p 2014 N93-21492 * #

NCEER-92-0015 ..... p 2059 N93-21818 #

NIAR-92-10 ..... p 1764 N93-21561 #

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NIFS-156 ..... p 2073 N93-20761 #
NIFS-158 ..... p 2070 N93-20156 #
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NIFS-171 ..... p 2075 N93-21567 #
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NIFS-174 ..... p 2072 N93-20543 #
NIFS-178 ..... p 2071 N93-20264 #
NIFS-182 ..... p 2071 N93-20265 #
NIFS-183 ..... p 2072 N93-20544 #
NIFS-186 ..... p 2073 N93-20763 #
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NIFS-189 ..... p 2072 N93-20547 #
NIFS-190 ..... p 2074 N93-21361 #
NIFS-191 ..... p 2033 N93-20548 #
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NIFS-194 ..... p 2050 N93-20267 #
NIFS-195 ..... p 2073 N93-20764 #
NIFS-196 ..... p 2074 N93-21362 #
NIFS-197 ..... p 2100 N93-20266 #
NIFS-198 ..... p 2074 N93-21193 #

NIPER-623 ..... p 1851 N93-21767 #
NIPER-630 ..... p 1861 N93-21722 #

NIST/GCR-92/613 ..... p 1878 N93-21650 #

NIST/SP-305-SUPPL-23 ..... p 2091 N93-21344 #
NIST/SP-500/203 ..... p 2040 N93-21351 #
NIST/SP-500/204 ..... p 2042 N93-21687 #
NIST/SP-839 ..... p 2068 N93-21505 #
NIST/SP-842 ..... p 2092 N93-21387 #
NIST/SP-843 ..... p 2001 N93-21801 #

NISTIR-3981 ..... p 1885 N93-21237 #
NISTIR-3991 ..... p 1885 N93-21493 #
NISTIR-4487 ..... p 1919 N93-21199 #
NISTIR-4864 ..... p 1860 N93-21030 #
NISTIR-4876 ..... p 2040 N93-21348 #
NISTIR-4881 ..... p 2064 N93-21828 #
NISTIR-4891 ..... p 2091 N93-21012 #
NISTIR-4896 ..... p 1788 N93-21467 #
NISTIR-4900 ..... p 2039 N93-21045 #
NISTIR-4902 ..... p 2040 N93-21239 #
NISTIR-4909 ..... p 2040 N93-21221 #
NISTIR-4910 ..... p 1860 N93-21471 #
NISTIR-4911 ..... p 1878 N93-21468 #
NISTIR-4912 ..... p 2092 N93-21504 #
NISTIR-4915 ..... p 2091 N93-21218 #
NISTIR-4929 ..... p 1893 N93-21257 #
NISTIR-4933 ..... p 2029 N93-21255 #
NISTIR-4942 ..... p 2093 N93-21690 #
NISTIR-4945 ..... p 1893 N93-21256 #

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NLR-TP-89387-U ..... p 1787 N93-20743 #
NLR-TP-90141-U ..... p 1821 N93-20744 #
NLR-TP-90327-U ..... p 2090 N93-20917 #
NLR-TP-91191-U ..... p 1761 N93-20911 #

NMRI-92-85 ..... p 2023 N93-20587 #

NOAA-DR-ERL-AOML-71 ..... p 2019 N93-21389 #

NOAA-DR-ERL-PMEL-40 ..... p 2019 N93-21688 #

NOAA-TM-ERL-AOML-70 ..... p 2015 N93-21503 #

NOAA-TM-ERL-ARL-195 ..... p 2056 N93-21341 #
NOAA-TM-ERL-ARL-197 ..... p 1990 N93-21238 #

NOAA-TM-ERL-FSL-3 ..... p 2013 N93-21202 #
NOAA-TM-ERL-FSL-4 ..... p 2013 N93-21229 #

NOAA-TM-ERL-PMEL-95 ..... p 2014 N93-21388 #

NOAA-TM-ERL-WPL-221 ..... p 1992 N93-21649 #
NOAA-TM-ERL-WPL-224 ..... p 1911 N93-21016 #
NOAA-TM-ERL-WPL-225 ..... p 1885 N93-21201 * #
NOAA-TM-ERL-WPL-226 ..... p 2092 N93-21475 #
NOAA-TM-ERL-WPL-227 ..... p 2014 N93-21452 #

NOAA-TM-NOS-ORCA-64 ..... p 1994 N93-21805 #

NOAA-TM-NWS-NHC-46 ..... p 2013 N93-21228 #

NOAA-TM-NWS-NMC-71 ..... p 2013 N93-21290 #

NOAA-TM-NWS-SR-142 ..... p 2013 N93-21227 #
NOAA-TM-NWS-SR-143 ..... p 2092 N93-21694 #

NOAA-TM-NWS-WR-152 ..... p 2013 N93-21200 #

NOAA/SW/DK-92/008A ..... p 1992 N93-21649 #

NOARL-CR-028-92 ..... p 2011 N93-20586 #

NOARL-TN-284 ..... p 1966 N93-20401 #

NOARL-44 ..... p 2058 N93-20358 #

NPL-DMM(A)-37 ..... p 1951 N93-21565
NPL-DMM(A)-44 ..... p 1951 N93-21566

NPL-QU-90 ..... p 1946 N93-20930

NPS-MA-93-004 ..... p 2055 N93-21242 #

NREL/CP-412-5007 ..... p 1861 N93-21765 #

NREL/TP-257-4655-PHASE-1 ..... p 1763 N93-21766 #
NREL/TP-411-5165 ..... p 1907 N93-21251 #

NRL/FR/5620-92-9522 ..... p 1880 N93-20013 #
NRL/FR/5632-92-9518 ..... p 1883 N93-20578 #
NRL/FR/7140-92-9391 ..... p 2018 N93-20564 #

NRL/MR/6386-92-7179 ..... p 1911 N93-21267 #
NRL/MR/6670-92-7155 ..... p 2061 N93-20604 #
NRL/MR/6770-92-7155 ..... p 2061 N93-20604 #

NSMRL-1182 ..... p 2023 N93-20587 #

NSWCDD/TR-92/509 ..... p 1761 N93-20405 #

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OCR-92-U-0488 ..... p 1980 N93-21754 #

OCS/MMS-91/0070 ..... p 1992 N93-21684 #

ONERA-NT-1991-4 ..... p 1839 N93-21289 #

ONERA-P-1992-2 ..... p 1881 N93-20230 #

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ONERA-1989-3 ..... p 2060 N93-21948 #

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ORNL/M-1741 ..... p 1953 N93-21994 #

ORNL/SUB-87-00184/03 ..... p 1844 N93-21842 #
ORNL/SUB-88-07685/03 ..... p 1876 N93-21999 #

ORNL/TM-12204 ..... p 2057 N93-21963 #

PAPER-C-1-1 ..... p 2034 N93-20824 #
PAPER-C-1-2 ..... p 2035 N93-20825 #
PAPER-C-1-3 ..... p 2035 N93-20826 #
PAPER-C-1-4 ..... p 2035 N93-20827 #
PAPER-C-1-5 ..... p 2035 N93-20828 #
PAPER-C-1-6 ..... p 2035 N93-20829 #
PAPER-C-2-1 ..... p 2035 N93-20830 #
PAPER-C-2-2 ..... p 2035 N93-20831 #
PAPER-C-2-4 ..... p 2036 N93-20832 #
PAPER-C-2-5 ..... p 2036 N93-20833 #
PAPER-C-2-6 ..... p 2036 N93-20834 #
PAPER-C-3-1 ..... p 2036 N93-20835 #
PAPER-C-3-2 ..... p 2036 N93-20836 #
PAPER-C-3-3 ..... p 1919 N93-20837 #
PAPER-C-3-4 ..... p 2037 N93-20838 #
PAPER-C-3-5 ..... p 1920 N93-20839 #

PASC-009.01.00 ..... p 1831 N93-19986 #

PB92-120120 ..... p 1866 N93-21716 #
PB92-147438 ..... p 1994 N93-21811 #
PB92-182567 ..... p 1867 N93-21717 #
PB92-204585 ..... p 1893 N93-21377 #
PB92-208198 ..... p 1989 N93-21028 #
PB92-213305 ..... p 1885 N93-21493 #
PB92-213404 ..... p 2040 N93-21348 #
PB92-213461 ..... p 2101 N93-21375 #
PB92-213479 ..... p 2101 N93-21376 #
PB92-213685 ..... p 1759 N93-21342 #
PB92-213693 ..... p 1759 N93-21343 #
PB92-213974 ..... p 1760 N93-21713 #
PB92-216258 ..... p 2086 N93-21743 #
PB92-217033 ..... p 2024 N93-21046 #
PB92-217330 ..... p 1989 N93-21011 #
PB92-217579 ..... p 2091 N93-21344 #
PB92-217785 ..... p 2103 N93-21349 #
PB92-217959 ..... p 2074 N93-21203 #
PB92-218114 ..... p 2056 N93-21341 #
PB92-218155 ..... p 2018 N93-21049 #
PB92-218171 ..... p 2018 N93-21031 #
PB92-218544 ..... p 1992 N93-21649 #
PB92-218650 ..... p 2001 N93-21783
PB92-218718 ..... p 2014 N93-21492 * #
PB92-218767 ..... p 2101 N93-21346 #
PB92-219658 ..... p 2012 N93-21014 #
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PB92-223239 ..... p 2024 N93-21498 #
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PB92-224286 ..... p 1991 N93-21466 #
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PB92-224666 ..... p 1916 N93-21715 #
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PB92-225358 ..... p 1824 N93-21048 #
PB92-225366 ..... p 1946 N93-21017 #
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PB92-226166 ..... p 1912 N93-21744 #
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PB92-226299 ..... p 2039 N93-21045 #
PB92-226307 ..... p 2091 N93-21012 #
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PB92-227198 ..... p 1885 N93-21201 * #
PB92-227248 ..... p 2013 N93-21202 #
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PB92-227461 ..... p 1993 N93-21784
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PB92-227891 ..... p 1878 N93-21465 #
PB92-228402 ..... p 2013 N93-21200 #
PB92-229178 ..... p 2040 N93-21351 #
PB92-229202 ..... p 1919 N93-21822 #
PB92-233188 ..... p 2014 N93-21502 #
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PB92-233238 ..... p 2092 N93-21500 #
PB92-235696 ..... p 1850 N93-21651 #
PB92-235738 ..... p 2015 N93-21503 #
PB92-235993 ..... p 2101 N93-21469 #
PB92-236009 ..... p 2101 N93-21470 #
PB92-238542 ..... p 2092 N93-21504 #
PB92-238625 ..... p 1860 N93-21471 #
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PB93-100147 ..... p 1992 N93-21654 #
PB93-100410 ..... p 2013 N93-21227 #
PB93-100931 ..... p 2001 N93-21785 #
PB93-101020 ..... p 1907 N93-21652 #
PB93-101160 ..... p 1861 N93-21683 #
PB93-101244 ..... p 1993 N93-21696 #
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PB93-101293 ..... p 1993 N93-21695 #
PB93-101905 ..... p 2092 N93-21694 #
PB93-102242 ..... p 1850 N93-21653 #
PB93-102259 ..... p 2068 N93-21505 #
PB93-105013 ..... p 2020 N93-21793 #
PB93-105609 ..... p 1992 N93-21655 #
PB93-105757 ..... p 1979 N93-21657 #
PB93-105971 ..... p 2013 N93-21228 #
PB93-106649 ..... p 2015 N93-21535 #
PB93-106730 ..... p 1992 N93-21656 #
PB93-106854 ..... p 1991 N93-21473 #
PB93-107514 ..... p 2021 N93-21230 #
PB93-107639 ..... p 2091 N93-21379 #
PB93-107951 ..... p 1988 N93-21550 #
PB93-108462 ..... p 2091 N93-21380 #
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PB93-108611 ..... p 2103 N93-21381 #
PB93-110120 ..... p 1987 N93-21353 #
PB93-110161 ..... p 1991 N93-21384 #
PB93-110468 ..... p 1946 N93-21232 #
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PB93-110500 ..... p 1903 N93-21382 #
PB93-110914 ..... p 2086 N93-21548 #
PB93-111029 ..... p 1990 N93-21378 #
PB93-111466 ..... p 1886 N93-21788 #
PB93-111508 ..... p 2049 N93-21802 #
PB93-111516 ..... p 2069 N93-21804 #
PB93-111763 ..... p 1903 N93-21383 #
PB93-111771 ..... p 1947 N93-21235 #
PB93-111896 ..... p 2101 N93-21786 #
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PB93-112225 ..... p 2013 N93-21229 #
PB93-112530 ..... p 2100 N93-21212 #
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UNIV. OF NORTH CAROLINA - CHAPEL HILL
CB#3912, Davis Library
BA/SS Dept.—Documents
Chapel Hill, NC 27599
(919) 962-1151 FAX: (919) 962-0484

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NORTH DAKOTA STATE UNIV. LIBRARY
Documents Office
Fargo, ND 58105
(701) 237-8886 FAX: (701) 237-7138
In cooperation with Univ. of North Dakota, Chester Fritz Library
Grand Forks

OHIO

STATE LIBRARY OF OHIO
Documents Dept.
65 South Front Street
Columbus, OH 43266
(614) 644-7051 FAX: (614) 752-9178

OKLAHOMA

OKLAHOMA DEPT. OF LIBRARIES
U.S. Govt. Information Div.
200 NE 18th Street
Oklahoma City, OK 73105-3298
(405) 521-2502, ext. 252, 253
FAX: (405) 525-7804

OKLAHOMA STATE UNIV.
Edmon Low Library
Documents Dept.
Stillwater, OK 74078
(405) 744-6546 FAX: (405) 744-5183

OREGON

PORTLAND STATE UNIV.
Millar Library
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Portland, OR 97207
(503) 725-3673 FAX: (503) 725-4527

PENNSYLVANIA

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Cooper Library
Public Documents Unit
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(803) 656-5174 FAX: (803) 656-3025
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TENNESSEE

MEMPHIS STATE UNIV. LIBRARIES
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(901) 678-2586 FAX: (901) 678-2511

TEXAS

TEXAS STATE LIBRARY
United States Documents
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Austin, TX 78711
(512) 463-5455 FAX: (512) 463-5436

TEXAS TECH. UNIV. LIBRARY
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Lubbock, TX 79409
(806) 742-2268 FAX: (806) 742-1920

UTAH

UTAH STATE UNIV.
Merrill Library & Learning Resources Center, UMC-3000
Documents Dept.
Logan, UT 84322-3000
(801) 750-2684 FAX: (801) 750-2677

VIRGINIA

UNIV. OF VIRGINIA
Alderman Library
Govt. Documents
Charlottesville, VA 22903-2498
(804) 924-3133 FAX: (804) 924-4337

WASHINGTON

WASHINGTON STATE LIBRARY
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Olympia, WA 98504-0111
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WEST VIRGINIA UNIV. LIBRARY
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(304) 293-3640

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ST. HIST. SOC. OF WISCONSIN LIBRARY
Govt. Publications Section
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(608) 262-2781 FAX: (608) 262-4711
In cooperation with Univ. of Wisconsin-Madison, Memorial Library

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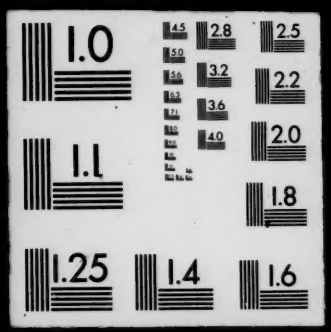
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